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Municipal Engineering

Chicago, Ill.
December, 1917.

Design, Construction, Operation and Maintenance of all Public Works

For the Amendment of Priority Order No. 2.

Certain features of Priority Order No. 2, promulgated by the Federal Government on October 27 and taking effect on November 1, have such possibilities for working far-reaching harm that they should be withdrawn. Briefly, the order forbids the use of railway gondola cars for: Hauling materials and supplies, other than coal, for the construction, maintenance or repair of public or private highways, roadways, streets or sidewalks; materials and supplies, other than coal, for the construction, maintenance or repair of theaters or other buildings or structures to be used for amusement purposes; material and supplies, other than coal, for the manufacture of pleasure vehicles, furniture or musical instruments; and, passenger vehicles, furniture and musical instruments. "Which articles," reads the order, "the undersigned (Robert S. Lovett) finds not essential to the national defense and security."

Some of the "articles" enumerated, such as places of amusement and musical instruments, are clearly not essential to national defense and security, but can the same be said of public highways? We think not. On the contrary, we hold that the rapid improvement of public highways is in the last degree essential to national defense and security, when those terms are broadly interpreted. The order classes roads with luxuries and amusements, whereas a modern road is distinctly utilitarian, although in improving living conditions it does incidentally give pleasure to its users.

The people of this country are in a road-building mood, after years of patient and expensive educational effort with that end in view, and it is questionable whether it is wise to issue an order of this kind, which is likely to plunge road building in this country back into the dark ages again. That the people want better roads is conclusively demonstrated by the number of road bond issues being voted in all parts of the country. If the war lasts two years and this order remains in full force road building will be set back a quarter century or more. This is a bad national prospect.

The suspension of road building, or its very serious curtailment, will adversely affect numerous important industries which have been generous supporters of the government's war policies and which have cheerfully paid war taxes and bought war bonds. Many of these industries were relying on road construction and repair work for enough business to keep them running during the war. To them this order is a very serious one indeed. Will there be other orders equally serious to other industries? If so, who will float the war loans?

But important as the foregoing considerations are, they are by no means most important. So far as the adverse effects on individual firms is concerned, these might be overlooked in the interest of the greatest good for the greatest number, but in times like these we must make very sure of that "greatest good."

It is interesting to consider the effect of this order on public opinion in enemy countries. When news came to this country that, despite the war, Germany was going on with the building of subways in Berlin the effect on public opinion in this country was marked. People reasoned, and rightly as events since have proved, that if Germany could carry on such an important constructional activity as subway building, conditions in that country could not be as bad as represented. Conversely, will not the news of the curtailment of road building by government order in this country create the impression in Germany that conditions are not sound here? And will not this tend to prolong the war? In our opinion both questions must be answered in the affirmative.

Many there are who hold with us that the rapid improvement of public highways is essential to national defense and security. Numerous conventions of business men have endorsed pretentious road building programs. The recent war convention of the Chamber of Commerce of the United States adopted by acclamation resolutions urging that the prompt improvement of public highways is important and should be forwarded in every proper way.

Not long ago President Wilson said: "It is perfectly obvious that you have got to have an intricate and perfect network of roads throughout the length and breadth of this great continent before you will have released the energies of America." The allies are depending on the energies of America. Unless they are released and given full play there is grave danger of losing the war. Road construction is, therefore, imperatively requisite to national defense and security.

The railroads are unequal to the demands made on them. This fact lead directly to the promulgation of the order under discussion—to release cars for other uses the shipment of road-making materials has been forbidden. Motor truck freight highways are proving their worth on such long runs as from Akron, Ohio, to Boston. We must have more of them as fast as they can be built. Road construction is almost as essential as ship construction—let us not overlook that fact.

German finance is the real wonder of the war. How has that country been able to float so many big war loans? By keeping the money in circulation and withdrawing it uniformly at many points as water is drawn from taps in a circulatory pipe system. Priority Order No. 2 is in effect a cutting of the pipe line. Fortunately there is strong probability that the embargo on road materials will be lifted before spring. Certainly it should be. Engineers and business men, in their conventions, should adopt resolutions looking to this end and should use their influence to have created a National Highway Board of the Council of National Defense—a board better qualified and with more time to pass on such matters than the present Priority Board.

Special Contributors for 1918

Published as an insert in this number of MUNICIPAL ENGINEERING is a list of special contributors to this journal for the year 1918. The list is made up wholly of names well known to readers of engineering literature. There will be at least one article from each of these contributors. One author will write a series of twelve articles on road construction, another a series of six articles on water works maintenance and operation, and while the other authors have promised to write but a single article each it is probable some will write more than one article.

The claim is frankly put forward that this is the greatest list of special contributors ever announced by an engineering journal. That claim is made in all sincerity and, as the lawyer puts it, "without fear of successful contradiction." Those who are at all familiar with the literature of the profession know these men as writers of constructive articles. Each man will write on his specialty.

These special articles are in themselves sufficient to make MUNICIPAL ENGINEERING of 1918 indispensible to all who are interested in the design, construction, operation and maintenance of public works. By public works we mean works designed by engineers and built with public funds. This includes, of course, work in the county, state and nation as well as in the city.

The articles will be addressed to workers in every branch of the field covered by this periodical, while some will deal wholly with design, others will deal wholly with construction, and still others will deal wholly with the problems incident to the maintenance and operation of public works. The interests of all classes of our readers will be kept in mind.

Naturally there will be many other contributors to MUNICIPAL ENGINEERING of 1918 than those announced in this issue. Those announced have already agreed to write articles for us; of course, many others will do so from time to time.

Go On Planning to Build

There are many obvious reasons why planning for public works construction should move forward steadily at this time. It is true that the end of the war is not in sight but it is likely the end will come suddenly when it does come. In that event there is likely to be a construction boom in this country and the city that is far advanced in the planning of its public improvements will be in a strategic position as compared with the city that must rush through its period of planning.

Ordinarily too little time is devoted to planning. Usually there is a long period of procrastination, followed by a short period of hectic haste in planning, and then the period of construction. Errors and miscalculations of all sorts creep into plans and projects prepared in great haste, and cities are a long time paying for their mistakes of this nature.

In general it may be said that cities that plan in haste repent at leisure. Now is a good building time and a great planning time. Plans can now be made at a minimum of expense and every city should plan its improvements for several years ahead so as to be prepared for every contingency that may arise. It is a patriotic duty to plan now just as much as it may be a patriotic duty to build when the ending of the war releases millions of men who can be utilized to their own and the public advantage in public works construction.

Motor Truck Freight Highways

Interest in motor transportation on highways is advancing in leaps and bounds. The existing transportation system has been unable to meet the demands laid upon it by the heavy war traffic. The railroads simply cannot move the freight that is brought to them. They are actually calling for help! After years of lobbying against other forms of transportation this new attitude on the part of the railroads is proof positive that they are unequal to the transportation demands of the times. Railroad men are even speaking a good word for their traditional enemy, the waterway!

A few days ago Hale Holden, President of the Chicago, Burlington and Quincy Railway, said: "We must make greater use of waterways, electric lines and motor trucks wherever practicable means can be developed to accomplish this, and no better time than the present can be found to make the experiment."

J. Denny O'Neil, Pennsylvania State Highway Commissioner, is authority for the statement that there are localities in Pennsylvaniia where it costs more to haul the produce to market, because of bad roads, than it does to transport it from America to France. What a striking illustration of the need of good freight highways, capable of handling motor truck traffic!

In speaking recently of transportation as one of the necessities of our national life Mr. S. M. Williams, of Lima, Ohio, said: "In former times in thinking of transportation our minds immediately went out to the railroads or waterways. The highways were not considered except as a matter of convenience for individual communities through which they traversed and owing to the miserable and unreliable conditions of the highways in many sections of the country, we have been paying a penalty of over two hundred and fifty million dollars per year in excessive cost for transporting our agricultural products alone from farm to market or shipping point."

Business men in all lines are endorsing the construction of motor freight highways as a necessary and sufficient form of reinforcement to our present transportation system. A bill is now awaiting Congressional action which proposes giving to the Postoffice Department power to establish a special motor truck collection system, with the object of effecting a more prompt and economical handling of foodstuffs between farm and consumer. Of course, roads capable of carrying heavy motor vehicles are requisite to the successful working of such a plan.

Bacon Was Right

In his preface to Maxims of the Law Sir Francis Bacon wrote: "I hold every man a debtor to his profession; from the which as men of course do seek to receive countenance and profit, so ought they of duty to endeavor themselves by way of amends to be a help and ornament thereunto." Yes, Bacon was right. The same thought, stated in modern but not less ornate English, was expressed a few years ago in the Code of Ethics of the Western Society of Engineers. One of the best, and one of the best recognized, means of "making amends" to the engineering profession is by exchanging knowledge through the engineering periodical. It is a real pleasure to acknowledge the cooperation of engineers in the making of the modern engineering journal—most engineers acknowledge their debt to the profession and take this means of paying it.

Methods Employed in the Construction of a Siphon Tunnel Under the Milwaukee River.

By A. L. Golinkin, Engineer Inspector, Sewerage Commission of the City of Milwaukee.

THE siphon tunnel discussed in this article is one of three large, concrete, double-deck siphons included in the construction of the new intercepting sewer system being built for the city of Milwaukee. Wis. In addition to the construction of the actual intercepting sewers, a complete disposal plant is also to be built, the entire project being carried on under the engineering supervision and direction of the Sewerage Commission of the city of Milwaukee. All work on this tunnel is being done by the John F. Casey Engineering and Construction Company of Pittsburg as part of a contract awarded them in April, 1916. The following discussion is limited to a general description of the siphon tunnel and a review of the constructional methods used in driving and concreting, but contains practically no data on design.

CONSTRUCTION VIEWS ON MILWAUKEE SEWER SIPHON TUNNEL UNDER RIVER. FIG. 1—HITTING DAYLIGHT—SHIELD JUST EMERGING AT RISER SHAFT—NOTE KEYBOARD AND TIMBERING. FIG. 2—HOUSING OVER DROP SHAFT. FIGS. 3 AND 4—METHOD OF DRIVING INNER SET OF 50-FT. BY 14-IN. LACKAWANNA STEEL PILING AT DROP SHAFT.

General

The intercepting sewer system is of the dual type. For purposes of general design the city was divided into four watersheds, each drained by one of the four watercourses in Milwaukee. Since each of these areas included lands too low to permit sewage to be delivered to the site selected for the disposal plant and also areas that would permit a gravity flow to the plant, the high and low level intercepting system was decided upon. At the point where the sewage is delivered to this siphon tunnel the high-level sewer has a diameter of 72 in., and the low-level sewer is 48 in. in diameter.

The sewage is delivered to the siphon at a drop shaft located at the corner of Fowler and West Water streets, at a point 128 ft. west of the west bank of the Milwaukee River and is carried to a riser shaft situated at the corner of Detroit and Broadway streets, a distance of 604 ft. from the east bank of the river and a total distance of 1,015 ft. from the drop shaft.

Compressed air was delivered to the tunnel immediately after the drop shaft was sunk and was used continuously thereafter. A maximum pressure of 21 lbs. per square inch was required during the early stages of the work, particularly when the eye of the tunnel was being cut, while an average pressure of 14 lbs. was sufficient for the remainder of the work.

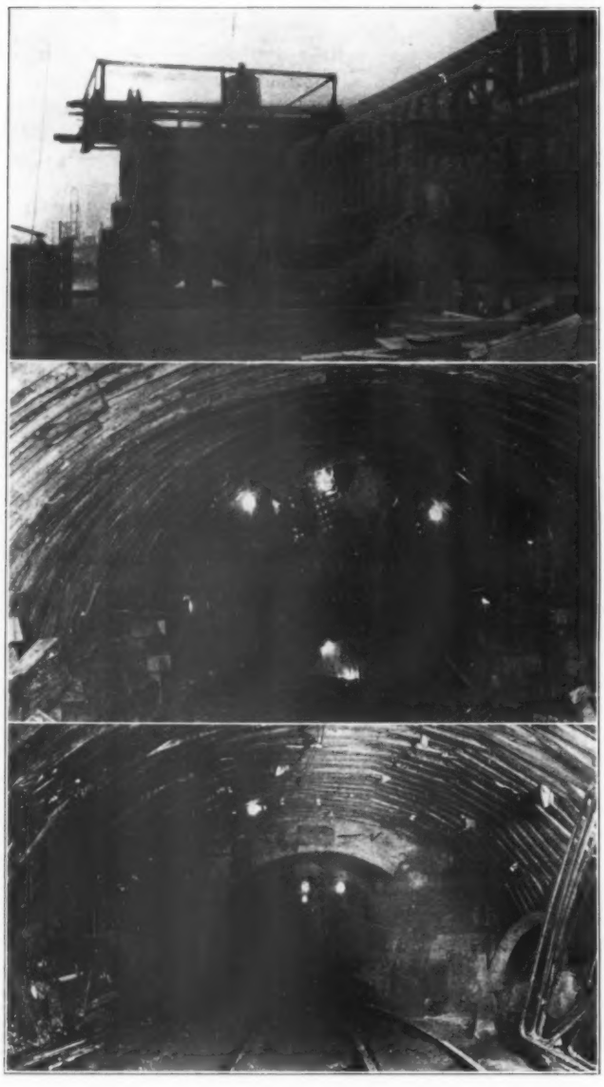
The power house constructed on the job contains three complete motor-driven compresser units, a steam boiler for the steam pumps, and a hydraulic pressure machine. The Watson Stillman hydraulic machine was driven by a 30 h. p. motor, its accumulator carried weights from 10 to 15 tons and was capable of furnishing a pressure up to 5,000 lbs. per square inch.

The Shafts

The site at West Water and Fowler streets being definitely chosen for the sinking of the drop shaft, work was commenced by the contractor on June 27, 1916. The shaft is rectangular in shape, has bottom dimensions of 23 ft.x23 ft. and is 16 ft. square on the bottom. It is excavated to a depth sufficient to give the top of the tunnel an elevation of minus 39. The material encountered at first was sand and stiff clay, but the character of the ground encountered at lower depths and

determinations made by several borings under the Milwaukee River indicated that below minus 39 it was probable that sand and gravel would constantly occur. To avoid tunneling in this material permission was granted the contractor to change the elevation of the top of the tunnel from minus 50 to minus 39.

The shaft was driven by means of Lackawanna steel sheathing. After the first set of 28-ft.x14-in. sheathing was placed, excavation was carried on to a depth of — 18.00, the



CONSTRUCTION VIEWS OF MILWAUKEE SEWER SIPHON TUNNEL. MIXER AND HOPPER AT TOP OF RISER SHAFT—OPERATING SHIELD IN TUNNEL—SECTION OF ARCH JUST INSIDE OF AIR LOCK.

second set of 50-ft.x14-in. sheathing was then arranged to form a complete box 16 ft. square, and each piece was driven separately and in place, insuring a tight, compact job. When excavation had progressed to within several feet of grade, grout pipes were driven in and a mushroom bottom grouted at the end of the sheathing, after which excavation was continued to grade and a 6-in. concrete slab poured. A cradle for the hydraulic shield was now constructed on the bottom of the shaft and the shield erected into place. A timber deck was then set several feet above the top of the shield, and the upper part of the shaft was immediately concreted in, all the steel sheathing being left in place. Air locks were now set in, compressed air was supplied and the eye for the tunnel was cut through the steel.

The inside dimensions of the riser shaft, which will include a valve chamber, is 16-ft.3-in.x17-ft.9-in. and was driven by the use of three sets of timber sheathing. The outside set was made up of 4-in.x10-in. timbers driven to a depth of 9 ft. This was followed by a box of 4-in.x8-in. timbers driven 20 ft., and the inside timbers were 4-in.x8-in. and 20 ft. long. After a 10-in. slab was placed on the bottom of the shaft, forms for the riser section of the 36-in. sewer were put in and concrete was poured to a depth of 6 ft. No more work was done on this shaft until the shield emerged through the sheathing, after which the wooden forms for the arch transition section were set. This transition section converts the arch section (or high-level sewer) into two 60-in. circular risers, one of which will connect through a "Y" special into the 60-in. high-level sewer on Broadway street. The other 60-in. riser of the transition section will be temporarily capped and made available for future connections. The 36-in. riser makes connections with the low-level concrete 68-in.x49-in. sewer on Broadway.

During all driving operations a 2-in. Nye pump was able to handle all seepage in the riser shaft, while a 3-in. Nye pump was required for the drop shaft.

Driving the Tunnel

The 1,015-ft. tunnel which connects the drop and riser shafts was driven circular in shape, with an outside diameter of 13 ft. The floor of the tunnel at the drop shaft heading is 49.09 ft. below water level, whence it slopes up at a grade of .14 per cent to a point beneath the east shore of the Milwaukee River, where the grade is changed to 3.2 per cent, and continues at this grade to the bottom of the riser shaft, the elevation here being 28.65 ft. below the river water level.

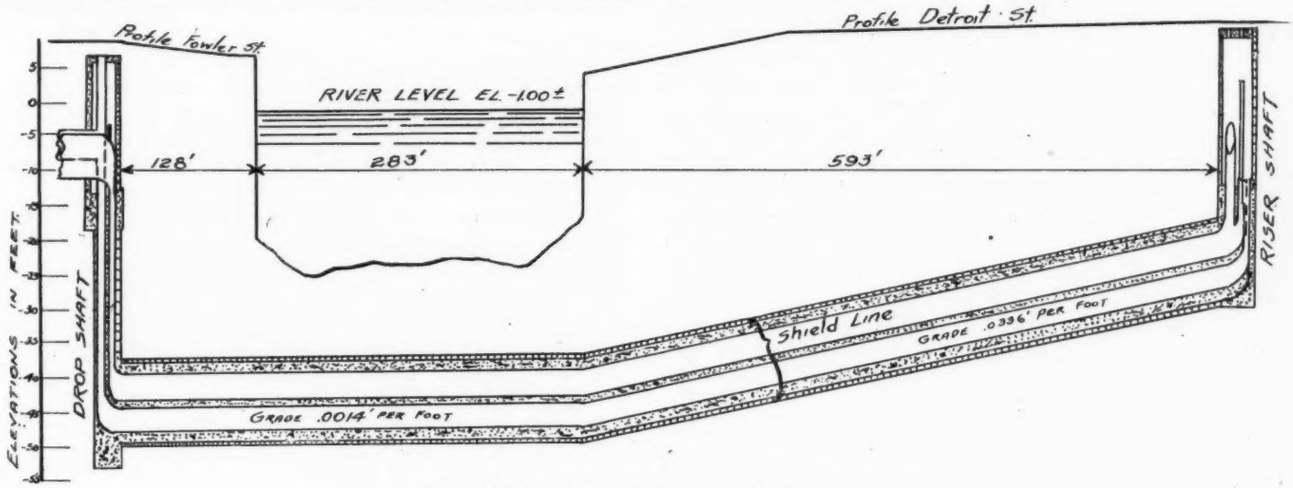
The tunnel was excavated by means of a hydraulic shield, which was 9 ft. 6 in. long and built of steel. Motive power was applied to it through 14 hydraulic jacks, each designed to carry a working pressure of 6,000 lbs. per square inch and having an extension of 22 in. Hydraulic pressure varying from 2,800 to 5,000 was sufficient to push the shield at all points in the tunnel. After 100 ft. of tunnel had been driven a steel airlock of two chambers was constructed and securely concreted into place.

As the shield was pushed along 6-in.x8-in. hardwood and 4-in.x8-in. yellow pine cants were placed the hydraulic jacks were pushed directly against them. This resulted in a very tight job of the timbering. The muck was shoveled into ½-yd. collapsible cars, which were pushed out through the material lock, led onto a hoist, lifted up and dumped into a hopper on top of the shaft and then delivered into auto trucks. The shield carried a platform placed on springline and a timber platform at the same elevation was built in the tunnel in successive sections as the shield was pushed along. Upon this platform the tracks were laid, which greatly facilitated the removal of muck by allowing the cars to be led directly into the shield. The shield was also divided into quadrants, two openings being below the platform and two above. The two miners in the lower part of the shield threw their muck onto a small timber platform, which was set within one foot of the bottom of the tunnel and carried along close to the shield; here it was relayed by two muckers to the springline platform and then thrown into the cars. The miners in the upper part of the shield dumped the muck directly into the cars, or threw it onto the tunnel platform, from which it was thrown into the cars.

After each push a check was made upon the shield by the engineer and data of the following nature were furnished the shield operator: (1) Position of shield with respect to center line of tunnel; (2) horizontal lead; (3) vertical lead; and (4),

grade. With this information the shield operator could constantly adjust the position of the shield.

After the tunneling had progressed to a point some 900 ft. from the drop shaft and the concrete had been carried up to station 8+91, a steel bulkhead was placed in both the arch and circular sections, a door being left in the arch so as not to interfer with the operation of the muck cars during mining.



PROFILE OF MILWAUKEE SIPHON TUNNEL.

A timbered box tunnel (a monkey drift) was now started from the riser shaft and carried in towards the shield. Meanwhile driving with the shield from the inside was continued, and when only 18 ft. of the marsh clay was left between the heading of the monkey drift and the cutting edge of the shield a material loss of compressed air occurred. The bulkhead door was now closed, the monkey drift was driven into the shield and the shield was driven straight ahead, completely "biting off" the smaller tunnel. When the shield finally reached the riser shaft the jacks were removed, the platform and pockets cut away, and the shell was allowed to remain in the ground.

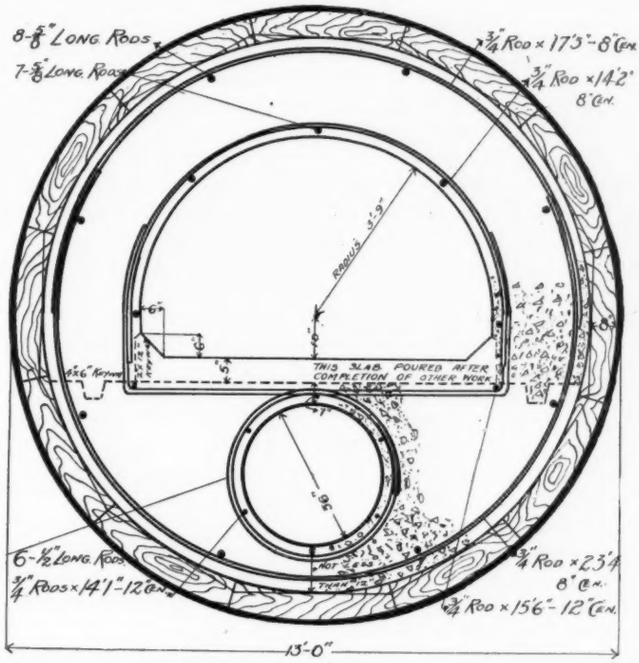
The character of the material encountered varied, although the greater portion of the last 600 ft. was marsh clay. For a considerable distance underneath the river large quantities of running sand and gravel were continually met with. This necessitated a constant breasting of the face at the cutting edge of the shield, but when the end of the river was reached and a change of grade occurred the shield gradually rose out of the sand into a uniform bed of marsh clay. Practically all work on the siphon tunnel was carried on 24 hours per day, employing three shifts of 17 men each. One day's mining and timbering averaged from 10 to 15 ft.

Concreting

The concrete work on the siphon tunnel was done in three distinct stages; first, the bottom was placed, entirely enclosing the 36-in. sewer, the top of the pour being 7 in. from the top of the circular forms; the arch was then concreted in, and finally a 5-in. slab was laid along the bottom of the arch section, making the total distance from the top of the 36-in. sewer to the flow line of the upper sewer 12 in.

In placing the lower sewer, circular steel forms built in 4-ft. lengths were used. The sections for putting in the concrete were set in various lengths, usually 47 ft., and after the proper reinforcing steel was set the section was closed off by means of temporary timber bulkheads, on which were placed 4-in.x6-in. keys. Since the platform built during the mining operations was entirely clear of this bottom pour, the ½-yd. cars of concrete could be brought in upon it to the place immediately above the section to be concreted and the concrete dumped directly into place. This permitted a minimum of shoveling, and by keeping two spaders continually below the platform a well-tamped concrete job was secured. A 4-in. galvanized iron pipe was carried along between the timbering and the forms, which succeeded in draining off the water.

In concreting the arch, hydraulic pressed steel forms were used. Each set of forms making an arch section of the correct dimensions, consisted of eight plates and one pair of pressed steel ribs. The plates were made in 4-ft. lengths of varying widths and had steel facings with laminated wooden backs. The forms were set up in 16-ft. sections, most of the steel reinforcing being set before the form ribs were put up, and the sections were closed off with timber bulkheads similar to those used in the bottom. By putting up the wall plates in single


8-⅞" LONG RODS
7-⅞" LONG RODS
¾" ROD × 17'3" - 8" CTS.
¾" ROD × 14'2" 8" CTS.
RADIUS 3'9"
THIS SLAB POURED AFTER COMPLETION OF OTHER WORK
6-½" LONG RODS
¾" RODS × 14'1" - 12" CTS.
¾" ROD × 23'4" 8" CTS.
¾" ROD × 15'6" - 12" CTS.
13'-0"

CROSS-SECTION OF MILWAUKEE SIPHON TUNNEL.

rows the concrete could be conveniently placed, tamped and inspected. Except for the two top key plates, each row of plates was clamped in as soon as the concrete had reached the top of the preceding row, but in "keying up" each 4-ft. section was entirely completed before the next pair of key plates were put up. Two-in. grout pipes were placed through the concrete

in the top of the arch every 16 ft., grout being pumped through them after all the rest of the concreting was completed.

After the bottom sewer and arch were concreted the 5-in. slab was placed. The surface on which the slab was to be laid was thoroughly cleaned and chipped and a rich mixture of concrete was placed through the entire length of the tunnel. The surface of the slab was carefully screeded and finished.

Except for the small section of tunnel adjoining the airlock, no concreting was done until the mining had progressed half way across the river, a distance of some 200 ft. Concreting of the bottom was then commenced and followed along about 100 ft. behind the shield. After the mining had progressed entirely across the river and the bottom section had been placed up to the same point, the shield work was entirely suspended and the arch section was concreted in. In placing this portion of the arch, work was started at a point about half way across the river and the concreting was carried on in both directions. The first 400 ft. of siphon tunnel was now completely concreted, except for the slab, and the mining was resumed. After this the concreting and mining were done alternately, each being carried on under the most favorable circumstances. The last 150 ft. of concrete work was done in free air, since that portion of the tunnel was open to the riser shaft; the remainder of the concreting was done, however, under compressed air.

A ½-yd. motor-driven mixer, stationed directly at the top of the drop shaft, delivered the concrete into collapsible cars, which were lowered by the shaft hoist, run through the material lock and into the tunnel. For the 150 ft. of open tunnel a mixer was placed at the top of the riser shaft and the concrete was delivered to the cars below by means of a chute. A 1:2½:4½ mix was used throughout.

Some Hints on Concreting in Cold Weather

During the first few days following the placing of concrete, alternate freezing and thawing at comparatively short intervals will damage it. The following suggestions relative to concreting in cold weather have been offered by the Portland Cement Association:

Although concrete which freezes before early hardening has been completed may not be permanently injured, if after thawing out it is not again exposed to freezing until hardened, protecting the concrete against possibility of freezing is best. Therefore it is necessary to so mix, place and protect the concrete that early hardening will be complete before the work is exposed to freezing temperatures. To do this:

(1) Sand and pebbles or broken stone used must be free from frost or lumps of frozen materials.

(2) If these materials contain frost or frozen lumps, thaw them out before using.

(3) As cement forms but a relatively small bulk of the materials in any batch of concrete, it need not be heated.

(4) Mixing water should always be heated.

Although adding common salt of mixing water will prevent freezing of concrete that has not hardened, there is a limit to the quantity of salt which may be added if the final strength of the concrete is not to be affected. Salt simply lowers the freezing point of the mixing water; it does not supply what is most needed—heat and warmth. It delays, instead of hastens, the hardening of the concrete.

Sand and pebbles or broken stone and mixing water must be heated so that the concrete when placed shall have a temperature of from 75 to 80 degrees.

Some sands are injured by too much heat. The same applies to certain varieties of pebbles and broken stone. A temperature not exceeding 150 degrees Fehrenheit will generally prove most satisfactory.

Place concrete immediately after mixing so that none of the heat will be lost before placing in the forms.

Warm metal forms and reinforcing before placing concrete. Be careful to remove ice and snow and frozen concrete remaining on forms from preceding work. Forms can be warmed by turning a jet of steam against them or by wetting with hot water.

Even though materials have been heated and the concrete placed immediately after mixing, it will lose much of its heat if not protected from low temperatures.

To protect the concrete immediately after placing. Canvas covering, sheating, housing-in the work, or hay or straw, properly applied will furnish the required protection for some work. In addition to these means, small oil or coke-burning stoves or salamanders may be used in enclosed structures.

Temperatures which may not be low enough to freeze the concrete may, nevertheless, delay its hardening for a considerable time. Do not expect concrete placed when the temperature is low and remains low for some time afterward to be safe for use as soon as though placed during warmer weather.

If concrete is unavoidably delayed or interrupted the work should be covered until concreting is again begun.

Cover and protect any section of the work as soon as completed. In severe cold weather, continue this protection for at least five days.

Forms must not be removed from the concrete work too early. This applies to any concrete work, regardless of season, but is particularly important with work done during cold weather.

Frozen concrete sometimes very closely resembles concrete that has thoroughly hardened. When frozen concrete is struck with a hammer, it will often ring like properly hardened concrete. Before removing forms, examine the work carefully to see whether it has hardened or is simply frozen. To determine this, remove one board from some section of a form, pour hot water on the concrete or turn the flame of a plumber's blow torch or a jet of steam under pressure against the concrete. If frozen, the heat will soften the concrete by thawing the water contained in it.

Road and Street Signs

The erection of handsome and durable signs, not only at the street corners, but far out on the roadways of the surrounding country, is coming to be fairly common among progressive American cities. In many places the municipal government is awake to the advantages thus secured, and in others the chamber of commerce or the automobile club has taken the marking of the streets and roads into its own hands as a matter of business enterprise and community betterment.

Out on the country roads, good, clear signs telling the direction and distance to important towns are as much appreciated by motorists as good road surfaces. "Keep to the right" signs at bridge and park entrances are often fully as effective as the services of a policeman.

The sign which was painted on a wooden board has been very useful in its day, but that day is past. People now demand something which is at once more attractive in appearance and capable of longer service. Sheet metal, protected by paint or by enamel, makes a very good sign for many purposes. Some of the enameled signs are quite handsome. They have the disadvantage, however, of not being able to withstand accidents or abuse. To meet such conditions, a sign of heavier metal and of very durable construction is demanded. One type is made from comparatively heavy plates of pure iron in which depressed letters are formed by a milling machine. A border is pressed around the edge of the plate, adding decidedly to appearance and rigidity. After the sign is galvanized, the letters are filled with a white compound. Then the remainder

face, recoating the body of the sign, but leaving the depressed letters untouched. This can easily be done without removing the sign from the post.

The relative visibility of different combinations of color, as between letters and background, has been made the subject of some interesting studies in connection with the science of optics. It seems now to be decided that white letters on a black background are readable at a greater distance than any

BLACK AND WHITE SIGN FORMED BY MILLING LETTERS ON ARMCO IRON PLATE AND FILLING WITH WHITE COMPOUND.

of the sign is covered with black paint or enamel. If the sign becomes soiled or defaced by years of exposure, its appearance can readily be restored by passing a point roller over the sur- other combination. Unless the weather conditions are such as to produce unusual darkness, well-formed white letters on a black background are easily readable at short distances at any time of night.

Cast iron signs are very durable, but are not adapted for all locations on account of the difficulty in maintaining a fresh and attractive appearance. There are, nevertheless, locations where they give very good service.

Cities Should Continue Planning Improvements During the War

By Alexander Potter, Consulting Engineer, 50 Church St., New York City

(The editor's influence has been steadily exerted in favor of continuing the construction of public improvements during the war. In our opinion the suspension of a great industry, like the construction industry, for the period of the war will not only be very bad for business generally, but will weaken the national morale and this will be quickly sensed by our enemies. This will prolong the war. But since there are bound to be some postponements of construction in response to the suggestion of the Secretary of War, and because of other considerations, this argument, by Mr. Potter, urging cities to go on planning improvements, is timely.—Editor.)

The Federal Government, through the Secretary of War, has recently requested municipal authorities to abandon public improvements during the period of the war, excepting such improvements as are absolutely necessary for the well-being of the municipalities or essential in the conduct of the war.

There is undoubtedly some construction work under way or contemplated which can be deferred until the end of the war without causing any serious inconvenience or affecting the health and well-being of the community. While the request of the government will unquestionably play havoc with certain contemplated plans, it is proper to inquire how municipalities can use to the best advantage this enforced inaction so far as construction work is concerned.

Cities Should Not Postpone Planning Public Works

In the request of the Federal Government there is not even an intimation that cities should postpone the proper investigation of contemplated improvements. Throughout the United States and Canada the period between the authorization of a project and its construction is in many cases entirely inadequate for the study and preparation of proper plans, and as a consequence glaring errors and mistakes have at times crept into public works which could have been avoided by a more thorough, painstaking and exhaustive examination of all conditions. It is unfortunately true that in too many instances it would seem that the point uppermost in the minds of many of the officials of municipalities is to get work on some plan started. The economic aspect of the project, the possibilities of so designing it as to make it adaptable for future expansion, and the proper, thorough and painstaking examination of various alternate plans which might be adopted are features which are given very much less consideration than they deserve. If, therefore, there can be brought home to the minds of officials the importance of using this period of enforced inaction, so far as construction is concerned, for a more careful working out of the details of projected plans it will be time well spent and will in the end tend to the betterment of public works. Too much time cannot be spent or too much study given to the development of well-considered and comprehensive plans, nor can the giving of sufficient time for the criticism of such plans by all who may be interested in their construction, be they taxpayers or city officials, result in the long run in anything but good.

Gain in Time Will Make Cities More Independent of Regulating Commissions

This situation, viewed from another standpoint, provides an excellent opportunity for the curtailment and eventual elimination of an evil that has assumed vast proportions and is destined, unless curbed, to assume still greater proportions. Throughout the country state and federal commissions of various sorts have been legislated into existence, clothed with arbitrary powers, in connection with all classes of public works. It would be absurd to deny that in many cases much good has resulted from the creation of these commissions. The work of these commissions overlap so that plans for a simple water works or sewerage system in some cities cannot be proceeded with until the plans, or certain phases of them, are approved by as many as four different commissions. If the appointees to these positions of trust and responsibility are not only honorable men, but men gifted with a sense of proportion, the evils which have arisen would not overbalance the good which they accomplish. It is not a difficult matter to select honorable men for these positions; it is, however, an exceedingly difficult task to secure an honorable man gifted with a proper sense of proportion. As a result of the selection of improper men many of these commissions are assuming arbitrary and unwarranted functions.

Under normal conditions these assumed powers, however arbitrarily applied, are allowed to pass without question, because, in the construction of public works, the effort put forth for the crystalization of the project and for the securing of the people's authorization have left the average official in such a state of mind that when the plans are finally submitted to one or more of the various state commissions whose approval is necessary before the actual work can proceed, he is willing

to accept any condition which these commissions may impose rather than risk any further delay. The possibility of injunction proceedings from one of a number of sources is often an added cause for acquiescence in intolerable and unjust conditions imposed by state and federal commissions. Therefore, the enforced delay in the execution of public works affords a most excellent opportunity for cities having schemes to put through to consummate the plans for such schemes and submit them to these various commissions. As there will be no particular advantage in securing the immediate assent of these commissions, officials of municipalities will be in a position to stand upon what they conceive to be their rights and oppose with all their vigor any unjust or unnecessary provisions or requirements which such commissions seek to impose upon municipalities. If the membership of these commissions and their employees are honorable men and have that sense of proportion with which they should be endowed, they will not seek to destroy, but will collaborate with cities in any just criticism of arbitrary action on the part of the commissions.

Cities Should Plan Now on Comprehensive Basis

In view of these conditions, it is to be hoped that municipal officers will not take the dictum of the Secretary of War as meaning that cities should shelve all consideration of these public improvements, but, on the contrary, cities should not only take advantage of the time at their disposal to develop to their full maturity plans for constructions that they have in contemplation, but should also look into the future and see what other plans for the welfare of the city might be suggested and developed in this time of waiting.

Among the public improvements that cannot be decided offhand, but which require long and careful consideration, might be mentioned the following:

(a) New or improved water supply;
(b) Purification of water supply;
(c) Systematic extensions of sewerage systems;
(d) Elimination of nuisances caused by the discharge of crude sewage into bodies of water too small to absorb the sewage;
(e) Street widening;
(f) Creation of public parks;
(g) Garbage disposal;
(h) Permanent pavements;
(i) City planning.

After the war is over there will be, at first at least, many idle men, and plans for the utilization of their labor along effective channels will prove to be of the highest value to the public welfare. With the cost of the war to meet, there will undoubtedly be a tendency to think that we must retrench in public improvements, whereas, after the war, the development of these public improvements will be the wisest, safest and best thing that the country can do to utilize labor and preserve the economic balance. In the meantime the force of engineers and men employed in the development of plans for these projects is relatively small, making few inroads upon the men needed for strictly war purposes.

If this conception is properly developed, it should result in great good for the country.

PAVEMENT DESIGN AND CONSTRUCTION

Combining Road Materials to Withstand Forces Incident to Motor Haulage

So severe has been the tax upon leading country roads that new expressions or terms have come into use, for example, sometimes it is said that a road has "failed" or has been "destroyed." In former years stone roads were described as "worn out," and, speaking generally, the statement signified prolonged service. The word "destruction" as applied to early roads, usually meant the ruin occasioned by torrential downpours, rapidly melting snows, or the overflowing of gutters and streams during protracted storms.

Some New Road Terms

It is a curious fact that in the destruction of stone roads today motor traffic operates along nature's lines, the difference relating to agencies rather than results. Where fast-flowing water washed away the road dust or binding material of stone roads, the rapidly revolving wheels of the motor car suck it up and disperse it in clouds of dust. Just as torrents loosened and displaced the stone, the motor car separates and scatters it.

Motor-propelled vehicles operating at high speed impose great stresses in the hard surface of a road. When this form of traffic consists in part of the transportation of heavy loads by motor trucks running on solid tires, it means severe strain upon road foundations.

Thus, when comparatively new and well-built stone roads succumb to traffic within a very brief period of time, as many of them do, it cannot be said, strictly speaking, that they have "worn out." Foundations have been crushed and wearing surfaces torn asunder; hence the terms "failed" and "destroyed."

To meet successfully the destructive forces described, whether imposed by traffic or the elements, engineers are putting down on heavy-traffic country roads a combination of materials peculiarly adapted to the purpose.

ILLUSTRATING COMBINATION OF ROAD MAKING MATERIALS TO WITHSTAND HEAVY HAULAGE.

Combined Concrete Base and Curb

Beginning with the road-bed or sub-base, they seek to bridge it with a material capable of sustaining great weight. While broken stone may be made sufficiently thick and compact to carry weight, a cheaper and more certain method consists of

spanning the sub-base with Portland cement concrete. The advantages of a road base of this type are many. The more important are as follows:

A concrete base is stronger than a stone base of like thickness. Cast in the form of a solid slab, concrete will bridge the sub-base. Thus any depression in the latter are spanned, whereas broken stone would be likely to settle at such points. In the case of a concrete slab, stresses are distributed instead of being confined to a small area. The thickness of a concrete base may vary in conformance with varying traffic requirements. A concrete base constitutes the greater part of the road—in many cases three-quarters of its thickness—which means that that much of the road is permanently established and should never require repairs or renewal if properly protected.

In putting down a concrete base it is an easy matter to cast integrally with the base substantial concrete curbs, which will prevent the wearing surface from breaking or spreading at the sides.

No highly technical processes or knowledge are required to construct a concrete base successfully. Any capable contractor can lay a concrete base.

When the wearing surface finally succumbs to traffic, it can be renewed without disturbing the base, which means virtually a new road at about half the cost of the original road, or perhaps less, the difference depending largely upon the cost of grading for the original road.

Thus engineers have solved the problems growing out of the destruction of roads by extreme weight of traffic. From every point of view a concrete base is a permanent and satisfactory investment.

Asphaltic Wearing Surface

The final step in the construction of the road is laying the wearing surface. Practical test under severe traffic conditions has demonstrated the utility and economy of the various types of asphaltic surfaces, when a thoroughly seasoned natural asphalt is used.

Asphalt is extremely tenacious, but not hard and brittle. Perhaps the best way to make this clear is to say that it is elastic under traffic as distinguished from a surface likely to spall or fracture. When a small irregularity in a newly-constructed asphalt surface disappears it is commonly described as having "ironed out" under traffic, which only a slightly plastic material would do.

Asphaltic surfaces are never transformed into dust or mud, and the stone in the wearing surface is not thrust aside or dispersed when bound with asphalt.

The slightly yielding or resilient property of asphalt provides a cushioning effect which prevents the road surface from crushing and powdering under the solid tires of the heavy motor truck.

Asphalt surfaces present an even and unbroken expanse upon which motor cars can run at high speed without jolting or damaging vibration. They are repaired with the same material used in original construction, hence the absence of disfiguring patches or streaks of contrasting color. An impervious asphalt surface protects the concrete base from extreme changes in temperature and moisture conditions, thus preventing destructive expansion and contraction.

Advantages of Combined Concrete and Asphalt Roads.

The theory that has led highway engineers to resort to asphalt and concrete for country roads can be explained in less than a dozen words: Concrete prevents roads from breaking down, and asphalt resists traffic wear.

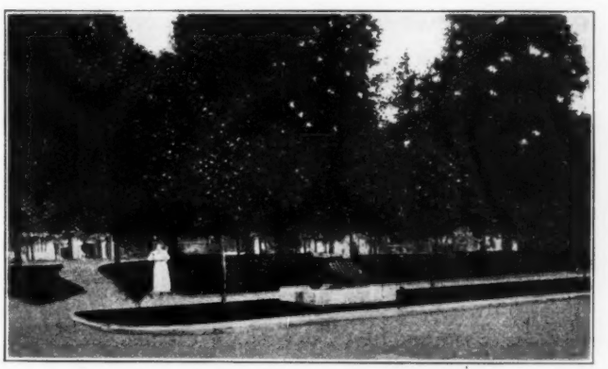
With motor-truck traffic increasing at a pace totally unforseen a few years ago, and with still greater increase in the volume of automobile traffic, important inter-city and interstate thoroughfares will be subjected to tests far more severe than anything encountered in the past, and the traffic a road is likely to carry will doubtless govern engineering decision as to the type of asphaltic surface to be applied. In some states engineers have resorted to sheet asphalt, such as is found on heavy traffic city streets. This has been adopted upon the conviction that ultimate economy will soon compensate for slightly higher initial cost. Next in point of durability comes asphaltic concrete, a little cheaper than sheet asphalt and not quite as dense. It is in this connection that the economy of the type of road described is emphasized. Should asphaltic concrete be adopted in the first instance and renewal be required after years of traffic, there could be substituted for it, should increased traffic warrant it, the higher class sheet asphalt, as the concrete base would be adapted to either type of sufrace.

Experience of Various Cities with Street Curbing Materials

The following information has been collected at first hand from officials of engineering departments in various American cities. The matter presented gives a good idea of the experience of cities, in the Middle West especially, with curbing materials.

Champaign, Ills. Fred C. Lohmann, City Engineer, uses concrete combined curb and gutter exclusively. The experience with this type of construction in Champaign has been favorable.

Chicago, Ills. Julius G. Gabelman, Chief Street Engineer of Chicago, reports that this city has natural sand stone curbing on a great number of streets although there is no precise record of the mileage in service. Very little maintenance is required on this curbing, though there is a small percentage of breakage at the joints. Chicago climatic conditions are rather extreme, ranging from 100 degrees in the summer down to about 30 degrees below zero in winter. Sand stone curbing has successfully withstood this climatic test. He reports that this type of curbing is easily repaired because a broken curb can be easily replaced or redressed. In connection with street widening and repaving, quantities of this curbing have been successfully taken up and relaid. Several types of sand stone curb are in service in Chicago on various streets and were placed at various dates and all have given good satisfaction. Mr. Gabelman considers that this type of curbing is unusually resistant to effects of the weather. A very small percentage of this curbing is cracked or chipped as a result of natural forces.



STREET SCENE IN LORAIN, OHIO, WHERE OVER 50 MILES OF NATURAL SANDSTONE CURBING ARE IN SERVICE.

Elgin, Ills. The prevailing practice in Elgin, as reported by M. H. Brightman, City Engineer, is to use concrete curbing. There is some sand stone curbing in the city that was placed prior to 15 years ago and this has given good service.

Evanston, Ills. The city of Evanston has in use about 400,000 linear feet of Berea sand stone curbing 4 ins. thick, and from 27 to 36 ins. in depth. I. C. Brower, commissioner of Public Works, reports that this curbing is all in good condition except for natural wear and tear and slight settlement in some places. Some maintenance and repair cost is necessary in connection with this curbing due to breakage by traffic teams and to settlement, expansion and contraction of pavements. Mr. Brower finds that this material is easily repaired and maintained because the material does not deteriorate and can easily be re-surfaced and relaid. He considers that the best curbing installation he ever put in was that on Colfax St. which was laid in 1916. This curb is a natural sand stone on concrete footings instead of lime stone curbing.

Moline, Ill. Lyle Payton, City Engineer of Moline, reports that they have considerable natural sand stone curbing installed in that city. On 12th Street, .83 miles was laid at a cost of $2,900.00 per mile, and 1.71 miles at the same price was laid on 4th. Ave. At a cost of $2,640.00 per mile, 1.62 miles was laid on 4th Ave., and 1.25 miles on 10th Street. Some maintenance and repair cost is required on this curbing, which is in good condition, owing to the heaving of frost which shoves and raises the curbing sometimes and in some places. There is also an abrasion on the curb by vehicles turning corners. Mr. Payton states the curbing he laid in 1910 on 16th St. between 11th and 19th Ave., of Kettle River sandstone, is the best curbing installation he has made. A negligible amount of curb cracks or chips and the same can be said about the amount of repairs or renewals that are necessary.

Indianapolis, Ind. B. J. T. Jeup, City Engineer, reports that about 25 years ago some 4x18 in. Berea sand stone was used in Indianapolis. This curbing was replaced by 5x24 in. stratified lime stone. The old curbing was in good condition when replaced and showed no signs of deterioration. The new pavement required a deeper curb and this was the only reason for removing the sand stone curbing. Mr. Jeup expresses a favorable opinion of the ability of this curbing to withstand climatic conditions.

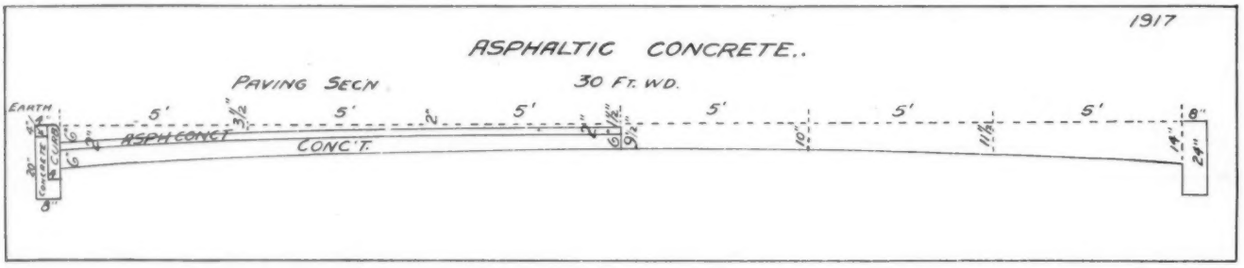
Terre Haute, Ind. Frank A. Kattman, City Engineer, reports that on radius curb corners granite curbing is used and in all other places concrete curbing or sawed lime stone is employed.

Davenport, Iowa. Roscoe E. Sawistowsky, City Engineer, reports the use of natural sand stone curbing on about 50 streets and aggregating 50 miles in all. This curbing is all in good condition. There has been some settlement of the curbing due to excavations in the street and this has necessitated a minor amount of maintenance cost. In Davenport the experience has been that sand stone curbing is easily repaired and satisfactorily maintained because of the ease with which it can be reset and retrimmed. There has been no cracking or chipping as a result of natural forces. Some repairs and renewals have been necessary at corners where heavy wear occurs.

Bay City, Mich. H. C. Thompson, City Engineer, reports that Bay City used Medina curbing up to about 10 years ago and since have been using concrete. The curb above the gutter is 6 ins. wide at the top, and 7 ins. wide at the junction with the gutter and is 18 ins. deep.

Detroit, Mich. On residence streets and streets with light traffic in Detroit, W. J. Wallace, paving engineer, reports that Amherst and Berea are used and with the exception of an occasional chipping due to an inferior piece of stone, these types of curbs are giving very good satisfaction. On business streets and streets with heavy traffic, Medina sandstone is used exclusively. On all streets, regardless of the type of curbing used, the circles are of Medina. The only instances in which Detroit has used concrete curbing in the past few years are where on account of transportation difficulties the contractor has been unable to furnish the stone curbing. There is shown herewith a cross section of a Detroit street showing a stone curb. Where concrete is used the size is 6x24 ins.

Grand Rapids, Mich. C. A. Paige, Asst. Engineer of the Department of Public Service, reports that the prevailing practice in this city is to use concrete curbing either straight or combined curb and gutter. There is quite a bit of sandstone curb in the city which was installed prior to 10 years ago and the department has occasion at times to reset it in the repaving of some streets. Mr. Paige considers it good curbing and says their use of concrete curbing is based entirely upon local cost consideration.



CROSS-SECTION OF A DETROIT STREET WITH NATURAL SANDSTONE CURB.

Kalamazoo, Mich. The city of Kalamazoo has used a variety of curbing materials as reported by A. Lenderink, City Engineer. These types comprise Berea stone, Medina stone, Bedford Lime stone, concrete curb and gutter and Laurel stone. Mr. Lenderink reports satisfaction with the use of sand stone curbing as he finds very few stones broken and these can easily be relined. At corners of course some repairs have been necessary.

Duluth, Minn. L. Ayres, City Engineer, reports extensive use of sand stone curbing in his city. Duluth has several miles of Berea laid about 1890 and still in good condition. The city is now using Kettle River sandstone for curbing.

Omaha, Neb. John A. Bruce, City Engineer, reports extensive use of Colorado stand stone for curbing. This stone is of a reddish color. He states that it has given excellent satisfaction. In a number of cases he has repaved streets curbed with this material and in very few cases has any new curb been necessary. All that has been necessary has been the readjustment of the old curb to the new line of grade. He estimates roughly that there are 100 miles of streets curbed with this material.

Buffalo, N. Y. Geo. H. Norton, City Engineer, reports extensive use of Medina sand stone. There has also been some Berea curbing laid, notably in the summer of 1916, when it was laid on two streets.

Columbus, Ohio. Practically all the curbing in Columbus is natural stand stone. The Columbus specifications are open

but nearly every street that is curbed is curbed with sand stone. This is the report of Henry Maetzel, City Engineer. He reports Columbus has taken up and relaid some of this curbing when streets were being repaved. He is a most enthusiastic champion of natural sand stone curbing and reports entire satisfaction with its use.

Lakewood, Ohio. Lakewood has about 70 miles of paved streets on which natural sand stone curbing is laid and it is all in good condition. The average cost of this curbing is $2,640.00 per mile, or 50c per lineal ft. C. A. Fisher says that this curb is easily redressed, reset and additional pieces are readily set in. The best sand stone curbing installation that he has put in is that on Lewis Drive made in 1916. There have been no failures from weather conditions.

Loraine, Ohio. C. M. Osborn, City Engineer, states that Loraine has over 50 miles of sand stone curbing. Some of this curbing has been in place for 20 years and is in good condition. In 1914 the cost was 47c per lineal ft. and in 1917, 60c per lineal ft. in place, including a bed of cinders. He reports complete satisfaction with the use of this material.

Mansfield, Ohio. W. J. Hazeltine, City Engineer, reports ¾ of a mile of Berea curbing on Wayne St., 3/5 of a mile on West 4th St., and 1.8 of a mile on East 5th St. All this is in excellent condition. Mr. Hazeltine states that the best sand stone curbing installation he ever put in was with Berea on South Main St., in 1896.

Marietta, Ohio. E. Frank Gates, City Engineer of Marietta, states that from 1892 to 1911 his city laid 22.6 miles of 5x18 in. Berea curbing at prices running from 32c to 45c per ft. It is all in use at this time and in excellent condition with no renewals for damage caused by natural causes and very few from any other causes.

Marion, Ohio. W. S. Ault, City Engineer, states that Marion has 40 miles of street paving and that on this paving 98% of the curbing is Berea sand stone measuring 5x18 ins. He finds the curbing easily repaired and maintained.

Youngstown, Ohio. F. M. Lillie, City Engineer, reports the exclusive use of natural sand stone curbing. They are mostly a local sand stone because of the cost consideration. He says that all sand stone curbing is good.

Zanesville, Ohio. C. R. Spencer, City Engineer, states that there has been nothing but concrete laid in his city for the last 10 years. Prior to that time a good deal of sand stone curbing was laid and this has proved satisfactory.

Pittsburg, Pa. N. S. Sprague, Chief Engineer, advises that until about 5 years ago all curbing installed was sand stone but since then protected (steel angle bar) concrete curb has been used exclusively. He reports satisfactory use of the sand stone curbing and calls attention to exceptionally good installations made in 1911 and 12, in the North Side flood district of several streets bounded by Federal St. to Goodrich St. River Ave. to Lacock St.

Memphis, Tenn. D. C. Miller, City Engineer, reports granite curb is easily obtained in Memphis and lasts indefinitely and so it is used almost exclusively although there is a very small amount of sand stone curbing in that city.

Outstanding Features of Road Work in Utah in 1917

By Ira R. Browning, Engineer, State Road Commission of Utah, Salt Lake City, Utah

The outstanding features of road work in Utah during the current year include the maintenance of 2,000 miles of established state roads, the grading of approximately 400 miles of highway, the paving of 10 miles and surfacing of approximately 100 miles.

The maintenance has been unusually difficult this season, due to the prolonged period of storm during the spring and followed by an unusual drouth. This has resulted in the breaking of the thin shale or clay surfaces on earth foundations and has rendered some of the newly graded roads nearly impassable. Repairing with the usual methods, equipment and materials has not proved adequate to sustain the heavy traffic on the surfaces that have become so badly disintegrated during the drouth.

The extension of the work of grading roads into the rural districts has brought large producing areas within reach of the markets for the first time in their history. Many roads that were formerly unfit for automobile traffic are being made into passable highways for motor vehicles.

For the year 1918 the program includes about 400 miles of roads to be improved under the Federal Aid Road Act, the paving of about 10 miles of important highway, the repairing or replacement of numerous highway bridges or culverts, and the establishment of road patrols for maintenance of all roads that sustain heavy traffic.

Some Features of Road Work in Kentucky

By Rodman Wiley, Kentucky Commissioner of Public Roads, Frankfort, Ky.

The Kentucky Department of Public Roads has for the past two years been advocating a type of floor for bridges which we believe, and which has proven, to be most satisfactory and yet rather inexpensive. Creosoted nailers are bolted to the top flanges of the joists, being sized in such a manner as to give a 1-in. crown to the roadway; two by fours which have been sized are then placed thereon and spiked to the nailers as well as to each other, and all points of contact are coated with hot tar. We believe that such a floor will last from eight to ten years. It is, of course, practically waterproof and stiffens the structure considerably; in fact, a floor of the above type can be placed on an old structure and remove the rattle almost entirely. It certainly is a great deal more economical than the ordinary wooden floor and because of this stiffening effect to the structure prolongs the life of the bridge several years.

Also in one of the counties in this state we have made a great many experiments as to the best methods of building a road, using river gravel. Clay has been used as a binder in all the experiments. We have tried placing the gravel in two courses, with the binder between; in other words, the sandwich method. The road would then be thoroughly harrowed, dragged, etc., in order to thoroughly incorporate the clay with the gravel. We have also tried placing the gravel in one course, with all the clay binder on top, after which the usual harrowing and dragging method would be used. It has been found in both the above cases that a good road can be built, but that it requires several months for the gravel to set up.

We are now placing the gravel in one course, the clay binder on top and plowing the material with an ordinary plow, and it has been found that is the best method for incorporating the binder with the gravel. If necessary, a harrow is then used to smooth the surface. It is then dragged and sets up in a short time.

This state has no law which allows the state to participate in the cost of maintaining roads, but it is highly probable that such a law will be passed at the next legislature.

As regards the work in this state for the year 1918, I will say we expect to do a considerable amount of Federal Aid work, and from present indications the various counties in the state will do about the usual amount of road work.

Motor Truck Haulage on Freight Highways

In a few years there will be freight highways and trucks will be kept off the roads used by pleasure cars; these freight ways will be heavier than roads being built today, and they will need to be, said George A. Ricker, Highway Engineer of the Portland Cement Association in addressing the Oklahoma Engineering Society. He ventured this prediction a year ago and a few days later came news that a freight highway had just been opened between Los Angeles and San Pedro. This road is 40 ft. wide, with a sub-base of stone, and it is surfaced with an 8-in. concrete pavement.

On these freight roads of the near future heavily loaded trucks, probably with trailers, will be carrying a lot of freight that is going by rail now, and from important terminal points there will be lighter trucks delivering to the door of the consumer. One of the greatest economic questions today is the distribution of the products of the country, particularly the food supply, and the freight highway is going to solve that problem. How great a part the motor truck and improved roads will play in the transportation of food, munitions and even troops in the near future we can only surmise. Under the stimulus of war preparation these to us new and vital questions are being given serious consideration.

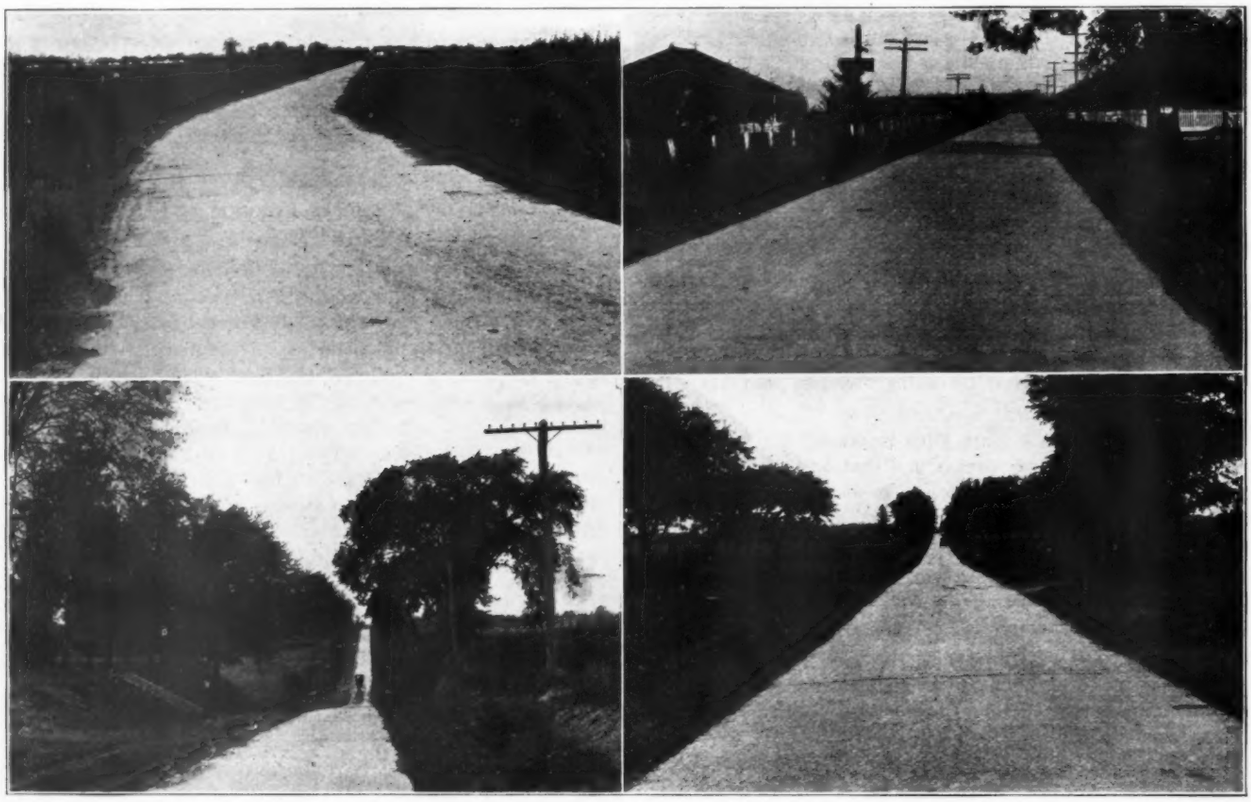
During this year of unusual business, under unusual conditions, there have been established regular motor truck operations between the larger cities of the East that have supplemented railroad freight service, which have proven entirely inadequate to the demands upon it.

Day and night communication over the highways have been maintained between the great manufacturing cities of Ohio and the seaboard. The transport of freight between Boston, New York and Philadelphia has been constant, and without this truck service business would have been more hampered than it was; we have it on good authority that "many a factory and business house in Cleveland would have shut down this summer, or have been run on part time, had it not been for the fleets of motor trucks that have poured over the roads from Akron, Elyria and other points."

Four Widely Separated, but Representative Concrete Highways

That concrete will figure prominently in the construction of freight highways is assured. Interest attaches to existing concrete roads and four representative ones are here illustrated.

The Axtell Road is in McLennan County, Texas, near Waco. It was built in 1915 and the photograph shown was taken in October, 1916. The road is 1,700 ft. long and 15 ft. wide. It is of 1:2:3½ concrete and is 4½ in. thick at the side and 6 in. at the crown. It is not reinforced. Joints are armored and are 30 ft. apart. This road was built by J. W. Bernard, Waco, contractor, and R. J. Windrow of the same city was engineer.



VIEWS OF FOUR WIDELY SEPARATED BUT REPRESENTATIVE CONCRETE ROADS. READING FROM LEFT TO RIGHT: AXTELL ROAD, McLENNAN CO., TEXAS; FOSTER ROAD, MULTONOMAH CO., OREGON; PERU CENTER ROAD, HURON CO., OHIO; HOLLY-BROCKPORT ROAD, ORLEANS CO., NEW YORK.

The Foster Road is in Multonomah County, Oregon, near the city of Portland. It was built in 1915. It is 21,571 ft. long and 18 ft. wide. It is of 1:1½:3 mix and was laid in one course. Joints are armored and 30 ft. apart. This road cost $1.25 per square yard and was built by the Montague O'Reilly Company of Portland, Ore., and was designed under the direction of State Highway Engineer Herbert Nunn.

The Peru Center Road is in Huron County, Ohio, near the city of Norwalk. It was built in 1915 and the photograph was taken October 15, 1916. The view features the satisfactory use of concrete on a grade. This road is 3,800 ft. long and is 10 ft. wide. The view shows the advantage in constructing a 10-ft. roadway on one side of the center line of the road so that an additional width may be placed when the traffic war-

rants it. This road is of 1:1½:3 mix and was laid in one course. It is 5½ in. thick at the side and 6¾ in. at the center. Joints are 50 ft. apart. The road is not reinforced and was laid on a clay foundation. It was built by Contractor Riley Pardo, of Norwalk, according to plans prepared under direction of L. C. Herrick. It cost $1.13 per square yard.

The Holly-Brockport Road is in Orleans County, New York. It was built in 1914-15 and the photograph was taken July 5, 1917. It is 2.4 miles long and 16 ft. wide. It was built by Contractor W. C. Rich, of Youngstown, N. Y., under the supervision of Perry Filkin, Division Engineer of the New York State Highway Commission, Rochester, N. Y.

PAVEMENT CLEANING AND MAINTENANCE

Method and Cost of Using Compressed Air Equipment in Making Street Openings

By H. L. Hicks, New York, N. Y.

The labor problem in municipal work, as in other fields of construction and maintenance, is calling for increased effort to replace men, who cannot be had, with machinery. For certain phases of the work pneumatic drills and kindred tools have proven their worth. Such drills as the Jackhamer, a 40-lb. self-rotating hand hammer drill, have taken almost entire possession of the field of rock removal in municipal contracting. It is but natural that, as contractors came to appreciate the handiness of a tool, they should begin to think of jobs, other than rock drilling, that could be done to better advantage by its use.

The removal of asphalt, concrete or block paving in opening streets for the laying of water, gas or sewer piping, electric conduits, etc., has been, by hand work, a relatively expensive job. By applying air tools the cost has been lessened, the work speeded up and better results obtained.

Removing Concrete Paving

In Des Moines, Iowa, electric service lines were to be laid in underground conduit. By hand methods it had been necessary to remove whole panels of concrete paving, in spite of the fact that a narrow trench was all that was needed.

The engineer introduced the Jackhamer and it was demonstrated that by using the air drill it was possible to restrict the cutting to a strip about a foot in width; a decided saving in the amount of pavement torn up. Hand work would have cost about 40 cts. per foot. With the introduction of two drills and an electric portable compressor it was estimated that the figure could be cut to 30 cts., but actual results showed a cost of 18 cts. per foot.

Removing Concrete Without Blasting

In cutting concrete, under such conditions as in the subway construction in New York City (Fig. 1), where the problem has been merely to tear out paving, foundations and other concrete without blasting, it is common practice to use a pointed chisel rather than the usual rock drill bit. As the rotation of the steel is unnecessary, shanks are made round instead of hexagonal. This, of course, renders the automatic steel rotating action of the drill inoperative. The chisel bit is very effective where concrete is of 3 or 4-in. thickness, as it permits the wedging and breaking off of relatively large chunks.

The problem of concrete pavement cutting has led to the adaptation of other air tools to the work. On part of the subway work, above mentioned, a heavy riveting hammer, when fitted with suitable chisel (Fig. 2), was found an excellent pneumatic pick. In other cases the pneumatic tie tamper has been fitted with a sharpened pick and developed (Fig. 7) into a conveniently handled concrete remover. In removing concrete pavement preparatory to replacing the rails of a Chicago street railway a strip 6 to 8 in. wide was torn out at a rate of 30 ft. per man per hour. Average performance reports indicate that pneumatic equipment will better the working speed of a gang of twice as many men using hand picks.

Removing Asphalt Paving

Somewhat akin to concrete removal is the taking up of

VIEWS ILLUSTRATING USE OF COMPRESSED AIR DRIVEN TOOLS ON STREET WORK. FIG. 1—BREAKING CONCRETE WITH JACKHAMER AND POINTED CHISEL BIT. FIG. 2—TEARING UP CONCRETE PAVING WITH PNEUMATIC RIVETER AND CHISEL. FIG. 3—CUTTING ASPHALT PAVING. FIG. 4—SCORING ASPHALT PAVING.

asphalt paving. For this service the tie tamper is a time and labor saver. A flat chisel of about 3 in. width is used. First the pavement is scored with the tool used as shown in Fig. 4. Then it is held upright as in Fig. 3 and the paving cut through and pried up. This method of applying tie tampers was developed by the street railways and shows such excellent saving that it will be undoubtedly applied by municipal contractors to similar work. At Elmira, N. Y., four men removed approximately 600 sq. ft. per hour, at a fraction of the cost of hand work.

Another tool also used for the same work is a smaller hand pick (Fig. 6). With this tool narrow grooves are cut, marking the portion of the asphalt to be removed, at an average rate of 20 lin. ft. per hour.

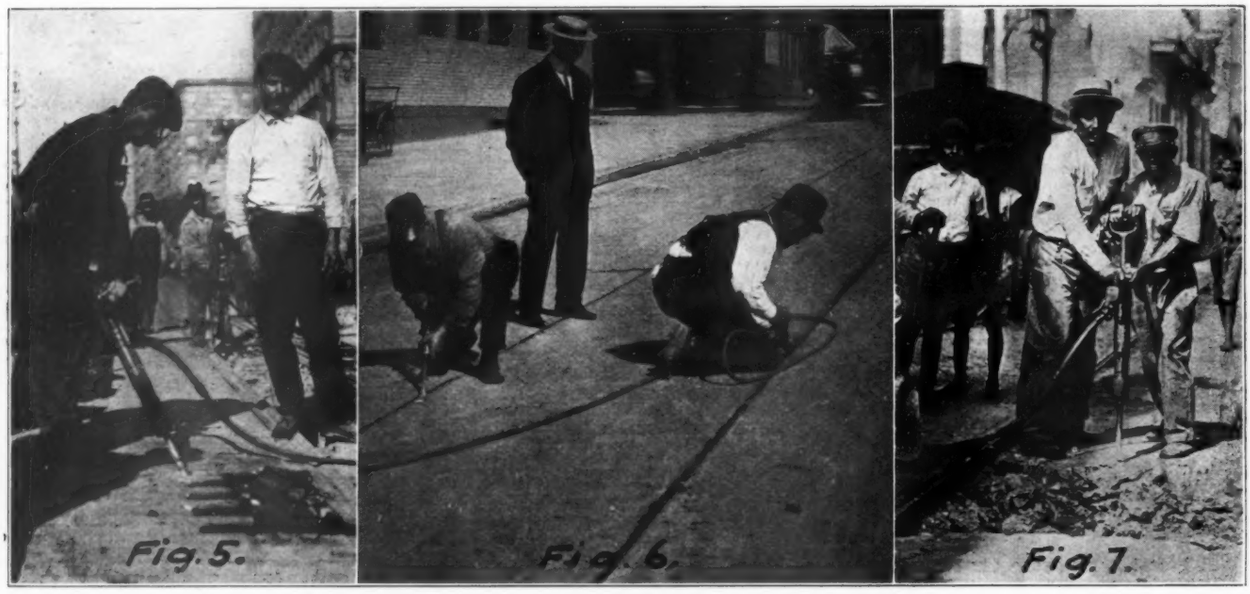
Removing Bitulithic Paving

Bitulithic pavement, being softer and of somewhat sticky nature, is removed in a slightly different manner. A chisel some 1½ or 2 in. in width is employed to make a series of cuts, each the width of the chisel and spaced about 2 in. apart.

Maintenance of State Trunk Highway System in Wisconsin

By A. R. Hirst, State Highway Engineer, Madison, Wis.

The Wisconsin Highway Commission has had in progress three experiments, one of which is along lines leading away from the beaten path. We have in this state many miles of sandy road far removed from ordinary construction and maintenance material. It has been the local practice to improve these roads by spreading hay, straw or other fibrous materials on the sand. This has given a very satisfactory road, but the effect is marked for only a short time as travel swiftly cuts the hay, etc., to pieces. We have been trying to improve on this practice by the addition of tar and sand with which we hope to form a tough, fibrous mat to carry travel. While our experimental roads have not been installed a sufficient length of time to warrant conclusions, their early showing is such as to cause us to have hopes that a cheap and efficient means of carrying travel over these sand roads may be perfected.



VIEWS ILLUSTRATING COMPRESSED AIR DRIVEN TOOLS ON STREET WORK. FIG. 5—REMOVING AND TOOTHING OUT BLOCK PAVING. FIG. 6—CUTTING ASPHALT WITH PNEUMATIC PAVEMENT PICKS. FIG. 7—ANOTHER CONCRETE CUTTING TOOL, THE PNEUMATIC TIE TAMPER, AT WORK.

Cuts of just sufficient depth to mark a distinct cleavage line are made on one side and the ends; the pavement is cut through on the remaining side, a crowbar is slipped under and the block or slab of pavement pried out. At Portland, Oregon, pavement of this kind was removed in slabs 4-ft.x4½-ft. at a cost of 49 cts. per square yard.

Removing Block Pavement

In tearing up block pavement (Fig. 5) any of the tools can be used, although a hand hammer is most useful when it comes to toothing out the edges of the section removed or cleaning used blocks of the adhering binder. With the introduction of air hammers a marked reduction in the breakage of blocks is to be noted. In one city where air tools are used it was found that a five-man gang using two hammers removed and cleaned 2,000 paving bricks in an 8-hour day—as compared with 1,000 brick for 10 men working by hand.

Entirely aside from the benefits derived from reduced cost of working is the improvement in public relations resultant from the shortened elapsed time during which streets are closed to traffic.

The Legislature of 1917, in the law assenting to the provisions of the Federal Aid Road Law provided that the State Highway Commission should select a State Trunk Highway System of not more than 5,000 miles or interconnecting all county seats and cities with a population of 5,000 or more. It provided that after May 1, 1918, this Trunk Highway System shall be maintained by the counties under the supervision of the State Highway Commission. The law provides further that the State's share of the cost of Federal Aid construction, and the cost of the maintenance of the Trunk System shall be financed from the proceeds of motor vehicle license fees.

The State Trunk System has been selected and the Commission is now making plans for next year's construction and maintenance program. It is expected that the Federal Aid construction program will amount to about $2,000,000 of which the Federal Government, the State and the Counties will each contribute one-third. As nearly as can be estimated, there will be available from the proceeds of automobile licenses for the maintenance of the Trunk Line System, about $175 per mile in 1918. The construction program contemplates Federal Aid work in approximately 50 counties. In selecting the

projects, the Commission has endeavored to locate the improvements on bad spots in important roads where there is little prospect of securing the improvement through local effort. The construction will not vary from state aid construction of the same type.

The outstanding feature of next year's work will be the maintenance of the Trunk System, and it is the intention of the Commission to make this work its first care. While there has been much high class road work done in this state, it has been badly scattered and there has been no systematic attention paid to the maintenance of the earth roads connecting the improved portions. It will be the aim next year to keep the entire 5,000-mile System in a good, passable condition all the time, and the energies of the Commission will be concentrated in an effort to build up a patrol system of maintenance which will attain this end.

The Best Method of Making Repairs to Pavements Torn Up For Water Works Construction

By John M. Diven, Superintendent of Water Works, Troy New York

With asphalt, bitulithic and other pavement on a concrete base, we have adopted the method in Troy of putting a concrete base in the excavation, after ramming the back-fill as hard as possible. Even though more soil is put back than is taken from an excavation it is, as we all know, very difficult to so fill a ditch that it will not settle any. To take care of this we use a very deep base, usually, on small excavations, much deeper than the original base. For service and small repair ditches the edges of the old concrete are cut with a bevel toward the opening, so that the new piece wedges in place, preventing the settlement even though there is some settling of the ground under the patch. This concrete patch is brought up to the level of the old foundation, or to the bottom of the finish coat and a piece of tar or other building paper laid on top of the new concrete, and a thin coat, the thickness of the surface finish of the pavement, of concrete put in. The paper prevents the thin finish coat adhering to the foundation course, so that it is easily broken up and removed when the regular repair gang comes along, said Mr. Diven in a discussion before the Central States Division of the American Water Works Association.

Patches of this kind often remain for a long time, frequently through a winter, and form a smooth efficient pavement surface. In at least one instance the repair gang have overlooked one such patch for several years. A little pains, and lamp black, will color the patch to fairly well match the old surface, so that it is hardly noticeable. If proper care is used the surface of the patch is absolutely even with the surrounding pavement and no jar is felt in driving over them.

We have used this method in Troy, N. Y., successfully on Hassam pavement, the only trouble being the greater difficulty in breaking out the surface course for final repairs, owing to its greater thickness. As there is no trouble in matching Hassam pavement in color the patches are frequently left, and some of them have stood heavy traffic for years. For these patches a rather fine gravel is used and mixed one to three with cement. No surface coat is used, simply tamping with an ordinary, square dirt tamper leaves a good surface.

The street flushers have made it impossible to continue the old method of filling with good sound gravel or other hard soil, keeping it surfaced till the ground is thoroughly settled and the pavement repair gang ready to put in permanent patches. The flushers gouge out such fills the first time over.

The above described method has not been used here over extension of mains, and, except in a much used street would probably prove too expensive; though it would undoubtedly be economical where a street improvement that was flushed nightly had been taken up to lay a water main. In some cases where the repair gang is due soon, the mixture is made poorer; just enough cement is used to hold the gravel in place against the force of the flusher stream for a few days.

WATER WORKS MAINTENANCE AND OPERATION

Methods Employed in Recovering a Pump From Bottom of Deep Well

By W. A. Judd, Water Commissioner, Mason City, Ia.

Well No. 9 at Mason City starts with a 19-in. hole which continues for 225 ft. At that point the diameter is reduced to 16 in. and at 540 ft. it is again reduced to 12 in. The well is 1,200 ft. deep. In this well is installed a 5-stage 17-in. American deep well turbine, motor driven. The turbine proper is at about 90 ft. below the well curb and below the turbine are two lengths of 9-in. suction pipe. Water normally stands in the well at about 85 ft. below the curb and pumps down about 7 ft. when yielding 1,200 gal. per minute.

The construction of this type of pump and its connections are well known. The weight of the pump is carried by the 10-in. flanged discharge pipe in 8-ft. lengths. Inside this discharge pipe is another pipe 4-in. outside diameter, held in position by spiders inserted in the flanges of the discharge pipe. This pipe is connected together by means of screw couplings, which also serve to hold the shaft bearings. Inside this pipe is the shaft.

Pump Overhauled Annually.

We make a practice of overhauling this pump once a year and were doing so on New Year's day of this year, said Mr. Judd in addressing the Iowa section of the American Water Works Association. The pump had been lowered together with four lengths of discharge pipe shaft casing and shafting. The fifth length of shafting had been screwed up tight and the fifth shaft casing was being set up solid when, without any warning, casing and shaft disappeared through the discharge pipe and with the pump and two lengths of discharge pipe went bubbling down to find a resting place on the ledge at 225 ft. below the surface. The two remaining lengths of discharge pipe were pulled out and it was found that in making up the shaft casing joint the discharge pipe had come loose from the flange.

Unsuccessful Effort to Couple to Shafting.

A well driller's advice was immediately sought, and he advised us to try to couple on to the shafting, which projects about a foot above the bearings. One of the shaft couplings was taken to a machine shop and the threads recut to make

a loose fit. One end was tapered out on the inside and the other end was cut down to a 2-in. pipe coupling. On the bottom was soldered a heavy funnel to center the coupling over the shaft. Two-in. pipe was then cut into about 10-ft. lengths for ease in handling and threaded. Because the shafting has a left-hand thread, it was necessary to drill each pipe coupling after the joint was made up and pin the pipe and coupling together. This was a tedious process, but finally the funnel was heard to strike the shaft. It was then raised and lowered a few times to be sure of contering and we started to twisting the pipe to the left. After several attempts it seemed to take hold and hoisting was attempted with an 8-ton chain hoist, which hangs from a trolley running on a 15-in. I-beam near the roof of the pump house. From the hard pull, we knew we had caught hold of the shaft, but at about the third pull on the chain, the coupling let loose and for a day we fished continuously without getting another nibble. The string of pipe was then pulled out and it was found that the funnel had bent over, allowing the shaft to center in the funnel, but to one side of the coupling. A heavier funnel was built, reinforced with steel ribs and bands, but even with this we had no luck, the shaft turning every time the threads engaged.

Special Fishing Tool Works Successfully.

During this time our day fireman had been telling of a fishing tool he had heard of, consisting of two rings. Just how the rings were operated no one knew until our blacksmith, who is a Britisher, said, "I gather you," and started to make the tool.

The small end of the funnel was cut off so the hole through it was about 5 in. in diameter. A fork was made to which the funnel was riveted. Above the fork was welded a piece of 2-in. shafting 3 ft. long in such a way that when the shaft and funnel stood vertical the face of the steel was about 2½ in. from the vertical line drawn through the center of the funnel. On the back side of this bar two ears were welded and punched for a 1-in. bolt. Two open rings were made, 5 in. in diameter, of ¾-in. square steel, with the ends bent back, flattened out and punched also for a 1-in. bolt. The top of the bar had a piece of 2-in. pipe welded to it, the rings were bolted to their places and wired together so they would move together on the bolts and a light wire was fastened to the top ring to hold them in horizontal position. The whole apparatus was then lowered into the well with the same 2-in. pipe, wire being paid out as the tool descended. The funnel centered the tool over the shaft casing all right, but when the rings were dropped by slacking the wire they did not bite into the casing enough to stand a pull, so the tool was again pulled out, a tool steel face put on the rings and then notched. A piece of flat tool steel was welded to the face of the vertical bar, and in it were cut some teeth, making it look like a wood rasp. The tool was again lowered and at 10:30 on the morning of the 7th of January caught hold of the shaft casing with a grip that scarcely anything could disengage. At the first pull it was evident that the pump was wedged tightly into the well, for instead of the pump rising the I-beam above was bending. Men were sent for props to put under the beam, but while they were gone the tension on the hoist suddenly slackened, showing that the pump was loose in the well, and pulling was started. At 10 o'clock that night, after pulling continuously, without stopping even to eat, the pump was landed on blocking on the well curb.

Experience with Leadite Joints at Windsor, Conn.

In drawing up proposals for the water mains contract at Windsor, Conn., alternative prices were asked; first, on laying cast iron pipes with cast lead joints; and, second, on laying cast iron pipes with leadite joints. The contractor to whom the work was awarded offered to do the work with leadite joints for 10 cts. per foot cheaper than with the lead joints. After favorable replies were received from several users of leadite, the officials determined to use that material. The experience gained in its use was reported by Superintendent Homer R. Turner:

Leadite was used on about 28,000 ft. of 10-in. water main. The material comes in the form of a black powder put up in 100-lb. bags. We used an ordinary portable furnace burning coke, controlling the temperature by dampening the fire with soil when necessary. One attendant is kept on this furnace continually, as the material requires constant stirring and proper control of the temperature to prevent burning. The leadite is melted until it is of the consistency of medium oil and the appearance of the surface of the liquid is smooth and free from bubbles. At this stage it has a mirror-like surface and is ready to pour. The temperature at this time is very slightly above the melting point and a higher temperature will cause bubbles to appear. Any increase in temperature will cause the material to thicken until it becomes stringy. If this occurs the pot should be removed from the fire and cooled until the temperature is reduced so that the material is of the proper consistency. Dry jute should be used in the joints. The presence of oil or grease from tarred jute prevents a good bond between the leadite and the cast iron pipe. The material is poured similar to lead. The leadite in the gate can be broken from the joint when cold and remelted after being properly cleaned. Experience proved that we have obtained better results with the joints if the pouring was kept back at least four lengths of pipe from the laying gang.

Use of Water Meters by Metropolitan Water District, Boston, Defers Construction New Works and Lowers Cost of Maintenance

The Metropolitan Water District of Massachusetts is at present made up of the following cities and towns: Arlington, Belmont, Boston, Chelsea, Everett, Lexington, Malden, Medford, Melrose, Milton, Nahant, Newton, Quincy, Revere, Somerville, Stoneham, Swampscott, Watertown and Winthrop. The Town of Swampscott was admitted under a special act of the Legislature, it being outside of the 10-mile limit prescribed in the act. The City of Newton, which is a part of the district, is still supplied from its own local source.

Previous to the formation of the Metropolitan Water District nearly all the cities and towns obtained their supplies from local and different sources and maintained separate pumping units, storage reservoirs and distribution systems. After the Metropolitan Works were put in service eleven sources of supply were abandoned and five pumping plants operated in place of twenty.

Introduction of Meterage.

In 1907 an act was passed that after January 1, 1908, all cities and towns which derived their source of supply from the Metropolitan Water Works should equip all new service pipes with water meters and should also equip annually with meters 5 per cent. of the services that were unmetered on December 31, 1907, and should thereafter charge each consumer in proportion to the amount of water used. The effects of meterage are here given as presented to the New England Water Works Association by Samuel Killam, Superintendent Pipe Lines and Reservoirs, Metropolitan Water Works.

The quantity of water consumed became a very important element and it was made incentive, not only for the district as a whole, but for each municipality, and finally, the most important of all, each consumer, to check and to stop the unnecessary and wasteful consumption of water.

The gradual installation of more service meters in the district has reduced the average daily consumption per inhabitant from 130 gals. in 1907 to 89 gals. in 1916.

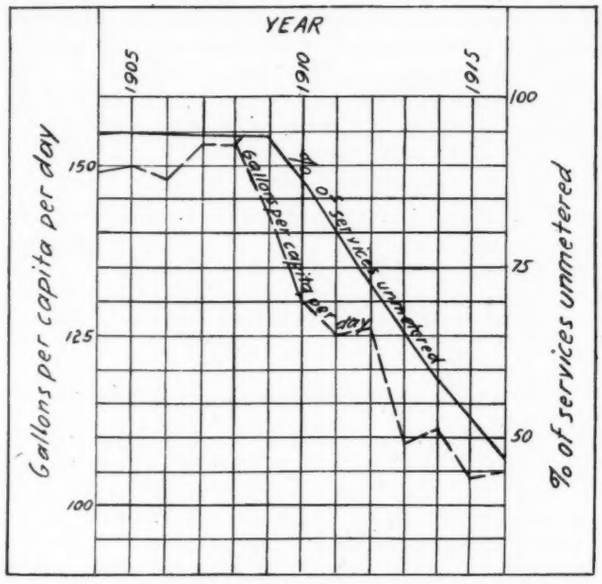


DIAGRAM SHOWING WATER CONSUMPTION PER CAPITA AND PERCENTAGE OF SERVICES UNMETERED IN THE CITY OF BOSTON.

The per cent. of services metered and the per capita consumption per day and at night in each city and town in the district for the years 1907 and 1916 were as given in Table I.

Table I—Per Cent. of Service Metered and Per Capita Consumption in Metropolitan Water District of Massachusetts.

City and Town.	Per Cent of Services Metered. Jan. 1, 1907.	Jan. 1, 1916.	Consumption Per Captia 1 a.m. to 4 a.m. 1907.	1916.	Av. Daily 1907.	1916.
Arlington	33.6	100.0	50	28	91	59
Belmont	100.0	100.0	31	18	68	52
Boston	5.5	53.2	107	62	153	106
Chelsea	14.6	99.7	59	35	97	68
Everett	2.0	50.0	50	42	82	74
Lexington	2.1	92.0	43	37	69	69
Malden	93.6	95.5	22	28	46	49
Medford	10.5	100.0	65	22	102	46
Melrose	3.9	100.0	85	26	117	45
Milton	100.0	100.0	16	10	46	42
Nahant	17.2	64.1	50	51	130	110
Quincy	14.2	88.6	66	39	100	59
Revere	4.8	70.8	54	34	82	59
Somerville	24.6	69.2	55	34	90	69
Stoneham	1.9	98.5	55	29	91	58
Swampscott	37.8	100.0	41	28	85	59
Watertown	98.3	100.0	36	29	67	65
Winthrop	2.3	100.0	65	26	105	53
District	14.7	66.8	88	51	130	89

The effect of the use of service meters upon consumption of water is very graphically illustrated by the accompanying diagram showing the daily number of gallons used per capita in the City of Boston and the percentage of unmetered taps for each year, 1904 to 1916 inclusive.

Meters Defer Construction of New Supply Works.

If the conditions as they existed prior to 1904 had been allowed to continue additional sources of supply would, without doubt, have been required before the present time. It is also probable that if the act requiring the installation of service meters on all works receiving a supply from the Metropolitan Works had not been enacted it would have been necessary to construct additional works by 1920.

The estimated safe capacity of the Cochituate, Sudbury and Nashua River Works is 173,000,000 gals. per day.

It was estimated in the report of the Metropolitan Water and Sewerage Board to the Legislature of 1904 that the cost of new works required within the next 25 years to supply the probable demand for water, if the waste was not checked, to be at least $32,000,000, assuming that the district remained as constituted at that time.

The greater the quantity of water used the more it cost in the end to furnish water to the tap. At a fixed rate the consumer is charged a certain sum and naturally is not directly interested in leaky pipes as long as no damage is caused by the water. The leaks increase in volume and the quantity of water required for legitimate use is running to waste. Wasted water means larger mains, more pumping machinery, wasted coal and labor and finally extension of works for larger supplies and an increased sewer system to care for the wasted water.

Many are willing to pay for their own and their neighbor's waste by general taxation, but are unwilling to continue to pay for their own waste when presented with a quarterly bill.

The writer believes that water meters are as much a part of a well operated water works system as gas or electric meters are to their respective works. Many gas companies account for 80 per cent. of gas delivered through the master meters. Well managed water works in Europe account for all but 10 per cent. of their supply. Cannot American municipalities do as well?

Waste of water can be divided into two classes, leakage from mains and waste from service pipes. The first can be stopped by efficient management and the latter by enlisting the consumer's co-operation by giving him a direct pecuniary benefit. It appears to the writer that the best way to get results is to sell the water by measure and to keep the measuring devices in good working condition. The writer maintains that the waste which has been stopped in the Metropolitan Water District of Boston by the installation of service meters has deferred for the present the construction of additional works and reduced the cost of maintaining existing works.

Method Successfully Employed in Repairing Leaks in Belleville, Wis., Concrete Standpipe

Following are the suggestions made to the Township Board, by the waterproofing engineer, and carried out by the board in repairing the leaks in the concrete standpipe at Belleville, Wis.:

Specifications

Thoroughly clean down the walls on the interior with a solution of muriatic acid and water, 1 part of sand to 10 parts of water. Roughen the walls as much as possible with any sort of tool that is convenient. Where each joint occurs cut into the concrete about 1 inch.

Over the entire wall surface apply a plaster coat ½ to ¾ in. thick, well troweled and worked into the joint where the greatest seepage occurs. It will be necessary on the inside to carry this plaster up 30 ft. The last 20 ft. appears to be in good condition and not subject to any seepage. This is due to the lower water pressure.

Mix for plaster to be 1 of Medusa waterproofed cement and 1½ clean, sharp sand and sufficient water to be added to make a mortar that will stick well on the concrete wall.

Before applying this mortar to the old concrete see that the

walls are well saturated with water and a grout applied to them composed of plain cement and water washed over with a brush. On the exterior of the walls from the ground up 10 ft. thoroughly clean off all white substance and roughen up and wash down as previously specified—also cut in about 1 inch at the joints and apply a plaster coat as on the inside. This is to protect the work that has been injured by the frost. To improve the appearance of the water standpipe paint the entire exterior with a mixture of Medusa waterproofed white cement mixed with sufficient water to make a creamy paste.

On one side of this structure is to be seen what appears to be quite a fracture in the concrete. This does not run through the entire thickness of the wall. The loose part of this fracture is to be removed, thoroughly cleaned and plastered over with the mixture described.

Where any small cracks are shown to leak, cut a joint into them and fill with the mixture specified.

Results of Repairs

The foregoing specifications, suggested by H. C. Morrison, western representative and waterproofing engineer of the Sandusky Cement Company, were carried out in making the repairs. This structure is now in perfect condition.

WATER WORKS DESIGN AND CONSTRUCTION

Method Employed in Constructing Ornamental Concrete Shell for Steel Water Tanks

The city of Cincinnati, having received complaints and opposition from real estate holders regarding the appearance of large steel water standpipes, has recently taken steps to improve conditions from an architectural standpoint, and ornamental concrete structures have been erected around the standpipes by the Ferro Concrete Construction Company.

EASTERN HILLS STANDPIPES, CINCINNATI WATER WORKS, ENCASED IN ORNAMENTAL CONCRETE SHELL.

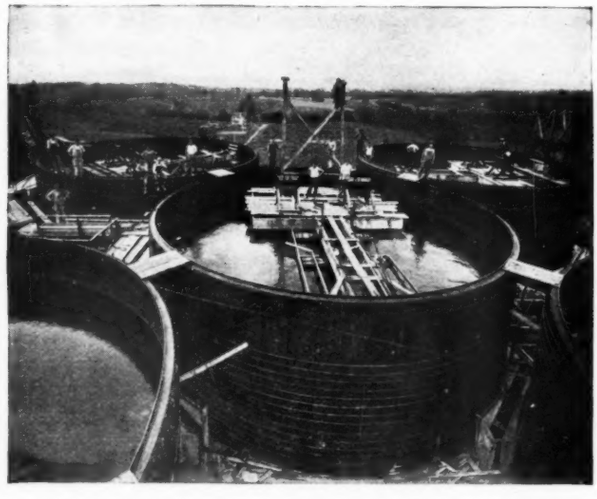
The accompanying illustrations show the Eastern Hills tanks almost completed. When finished, the top of the structure will present the appearance of the battlements of an old fort.

There are five tanks in the group on Eastern Hills and their relative positions will be seen from the illustrations.

Method of Erecting Forms

After the steel cylinders had been erected they were filled with water so that they would have the same shape as when in actual service. It was feared if concrete was poured while they were empty, slight changes in shape might take place when the water was let in, and this would cause cracking of the concrete shell.

The forms for the first section setting were supported on the foundation and braced to the ground. Forms for subsequent settings were raised from floats which can be seen in one of the illustrations. A lifting derrick will be seen at the extreme right of one of the illustrations. The derrick rests on a two-boom crab-operated rig resting on empty oil barrels on the water surface of each of the four corner tanks. Since each panel weighs about a ton, it is practically impossible to pick this weight from a floating platform of reasonable cost which would fit in a 40-ft. circle. Flotation is therefore used only when rotating the rig from one form to the next. In order to support the load the rear end of each float is blocked down from the Z-bar which forms the top of each tank, and the forward end is held by hooks over this Z-bar.



RAISING CONCRETE FORMS FROM FLOATS IN ENCASING CINCINNATI STANDPIPES.

No Interruption in Concreting

The foundation plan was about 100 ft. on the side and from 270 to 300 yds. of concrete is required for a complete lift, this to be distributed over a considerable area. It was therefore possible, by using stop planks, to concrete one-half of the structure while the horizontal reinforcing was being set and

while the forms were being raised on the other half; thus the mixing plant was kept going at the rate of 100 yds. or more a day. The total volume of concrete placed, exclusive of footings, was about 3,800 cu. yds.

The hoisting tower is double, one side being used for the concrete skip and the other having an elevator for the workmen. The tower also has a boom for raising the reinforcing.

Personnel

The tanks were designed and built under the direction of J. A. Hiller, general superintendent of the Cincinnati Water Works. T. J. Mulloy is resident engineer in charge. The Ferro Concrete Construction Company, of which W. P. Anderson is president, are the contractors. J. Hodges is in charge of the work for the contractors, while the forms and methods of construction were designed by Henry D. Loring, engineer for this firm.

Design and Construction of Water and Sewer Systems at Camp Custer, Battle Creek, Mich.

By Don W. Bingham, B. C. E., Assistant State Sanitary Engineer, Michigan State Board of Health

The National Army cantonment at Battle Creek, known as Camp Custer, is of the standard divisional type and will house the 85th Division of the National Army. The barracks are two-story type and contain kitchen and mess hall facilities. Toilet and shower bath accommodations are provided in separate buildings, one for each barrack. Heat is provided by steam plants, one to each regiment. Steam pipes between buildings are carried overhead on poles placed 21 ft. centers. Hot water for the shower baths is provided by heaters connected with the steam heating plants.

Water Supply

The water supply of the camp is derived from eight 10-in. driven wells which penetrate the Marshall sand stone. These wells average 110 ft. in depth and rock was struck at from 50 to 60 ft. below the surface.

Pumping and Storage

The pumping equipment consists of two pumping stations, each equipped with vertical centrifugal pumps direct connected with 220-volt, 3-phase, 60-cycle A. C. motors. The low level station, located at the wells, is further equipped with two electrically driven vacuum pumps for priming purposes and an emergency sterilizing outfit consisting of two liquid chlorine machines. The last mentioned devices were found to be invaluable in the cleansing of the distribution system when it was put into service. A thorough cleansing of the pipes was made necessary by the fact that a river crossing was made and that 2,000 ft. of the supply line was laid through a swamp.

The river station lifts the water to a hill near the camp, where are located four redwood tanks, each with a capacity of 200,000 gal. The high-level or booster pumping station is located at this point. The equipment at this station consists of seven vertical centrifugal pumps, direct connected, with a recording Venturi meter. The pumps are so connected that they can draw from the supply main direct or from any one or all of the storage tanks. It will undoubtedly not be found necessary to run the booster station except in case of peak load and at times of fire. The elevation of the tanks is such that sufficient pressure for ordinary use is obtained by gravity. The system was designed on a basis of 55 gals. per capita for about 40,000 men. A recent pump test showed that with two pumps running at the well station 2,600,000 gals. of water was obtainable per 24 hours.

Distribution System

The distribution system consists entirely of wood-stave pipe ranging in size from 6 to 12 in. The system is of the gridiron type and there are no dead ends except a few lines among the stables, and these are for fire protection only. All dead ends are provided with hydrants.

Sewerage System

The sewerage system is built entirely on the separate plan and consists of about 110,000 ft. of salt-glazed vitrified bell and spigot pipe ranging in size from 6 to 30 in. Cement and oakum joints were used, and they worked out very well, as the trenches were all in dry sand and no infiltration is to be expected.

The following minimum grades were used. They give a velocity of 2 ft. per second, flowing full, by Kutter's formula with n=13:

Diameter of Sewer, in.	Minimum Grade.
6	.5%
8	.36%
10	.28%
12	.20%
15	.16%
18	.14%
22	.12%
24	.10%
27	.08%
30	.07%

Sewage Pumping Station

Due to the topography it was necessary to construct one small pumping station and to divide the main collecting system into two separate sections, each with its outfall sewer and treatment plant.

The pumping station cares for three of the ten infantry regiments and consists of a pump pit and wet well. The pumping equipment is composed of three horizontal centrifugal pumps direct connected to 220-volt, 60-cycle, 3-phase A. C. motors, float controlled. There are two 4-in. and one 6-in. pumps in this station. The force main is 12-in. wood-stave pipe, 1,800 ft. long, and discharges into the high end of the main collecting system.

Sewage Treatment

The ultimate means of disposal is the Kalamazoo River, but before discharging the sewage into the river it passes through grit chambers and settling tanks. Grit chambers were provided because of the sandy nature of the soil and of the training given the recruits, which makes it inevitable that considerable quantities of sand will cling to their clothing and bodies, thus making the drawing of the sludge from the settling tanks a difficult procedure. The sludge will be disposed of by ditching, for the present at least.

Trenching

Trenching for water and sewer pipes was done by machine. Water pipes were laid with 5-ft. cover. The depth of sewers ranged from 4 to 17 ft., with an average of about 7 ft. As high as 3,900 ft. of sewer was laid in one day of ten hours with five machines. Less than 1,000 ft. of ditch and water pipe laid was considered a poor day's work for machine and crew. The largest amount of ditch cut by any one trencher in ten hours was 1,900 ft., 5 ft. deep. Eight trenching machines were in use on the work and 20 mechanical back fillers.

Personnel

Construction of the camp was under the supervision of Major E. B. Morden, Q. M. C., U. S. R., Construction Quartermaster; J. L. Lee, Supervising Engineer, and Samuel A. Greeley, Consulting Engineer on Water and Sewerage. The writer acted in the capacity of assistant and designing engineer of the sewerage system.

BRIDGES AND BUILDINGS

Design and Construction of the Third Avenue, South, Concrete-Steel Arch Bridge, Minneapolis, Minn.

By Chas. F. Bornefeld, Resident Engineer for Concrete-Steel Engineering Co., Consulting Engineers, New York City.

The new Third Avenue South Concrete-Steel Arch Bridge in Minneapolis is nearing completion, as the accompanying views show. The bridge is 2,223 ft. long and consists of seven main river spans. The bridge is partly curved in plan and has arches of two types. The 211 ft. spans have three arch ribs carrying crosswalks, and the 134 ft. spans have barrel arches. All arches are reinforced by steel truss ribs. The concrete was placed from a cableway of 2,038 ft. span, through drop-bottom buckets.

The bridge spans the Mississippi River. Because of its size and the difficulties encountered on the construction the bridge has features of interest to engineers and contractors.

Troublesome geological conditions led to the adoption of a partially curved plan. The formation at the site consists of limestone ledge rock about 15 ft. thick. This rises almost to the water in the west channel and is covered with a few feet of silt and sand in the east channel. The limestone is underlain by St. Peter sandstone in a bed 600 ft. thick. This sandstone is soft enough to loosen easily under the pick and is readily eroded by water under pressure. The ledge of limestone extends about 500 ft. upstream and about 700 ft. downstream to the crest of St. Anthony Falls.

Why Plan is Curved.

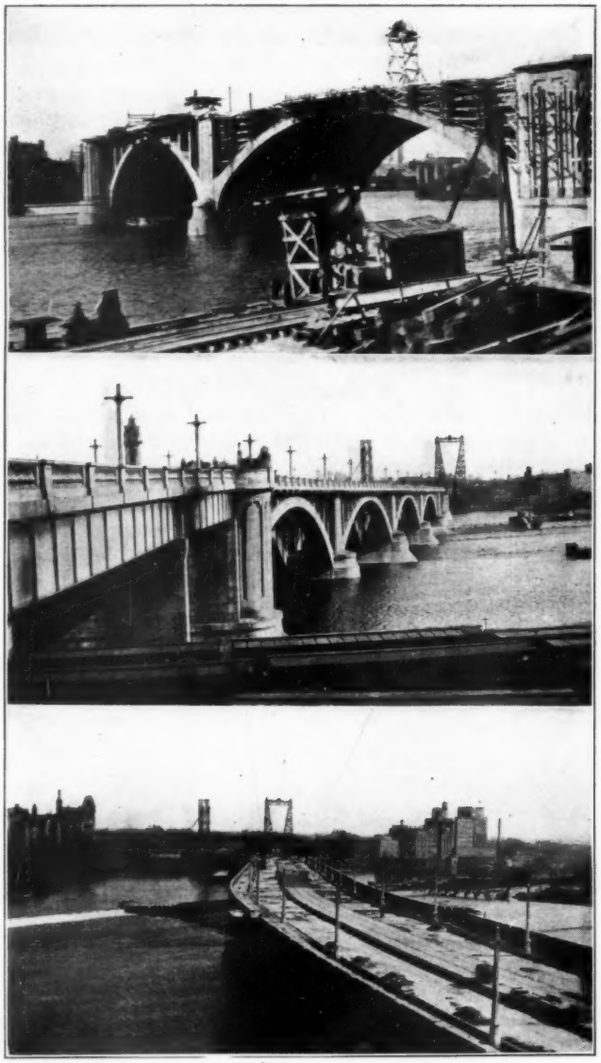
Conditions of unusual interest in the rock led to the location of the piers which made necessary a partially curved plan. Years ago tunnels were driven through the soft sandstone so that power from St. Anthony Falls could be utilized in the construction of public works. The water was led from the mill pond in a canal above the limestone and the tunnels served as tailraces. In 1869 one of these tunnels had reached a point near the foot of Nicollet Island (2,000 ft. from the point of beginning), when water poured in from a break in the overlying bed of limestone. The project was abandoned, and the United States Government made extensive repairs to close the break in order to insure continuance of the water-power and restore the original conditions as far as possible. Another break occured in 1876. The locations of these breaks in the river bed and their relation to the bridge site controlled the location of the bridge piers and this determined the alignment of the structure.

For years there has been a strong demand for a bridge in this locality. A handsome structure was desired and a concrete arch structure was considered the best type and was chosen.

The bridge is 2,223 ft. long and consists of seven main river spans. It has a 54-ft. roadway (with double-track street railway) and two 12-ft. sidewalks. The loading provides for two 40-ton cars and 100 lb. per sq. ft. uniform load. The floor system is designed to carry a 24-ton road roller on a space of 12x18½ ft. The center line starts at the intersection of Third Ave. South and First St. at an angle of 21 deg. 39 min., and is on a tangent for 151 ft. to a 4-deg. curve 330.2 ft. long. A tangent 719 ft. long continues to a curve consisting of a 4 deg. compound into a 10 deg. curve in a distance of 526.83 ft., bringing the center line of the bridge to that of First Ave. Southeast. The bridge is level, with the grade of 0.9% on the east approach and 3.4% on the west approach.

There are five 211-ft. spans with piers 20 ft. wide as springing line and two 134-ft. spans with an intermediate pier 13.79 ft. wide. The two end, or abutment, piers and the pier between the 211-ft. and 134-ft. spans are 30 ft. wide. The approaches are steel girder spans on thin piers. All the river piers are skew to the center line. The 211-ft. spans are on the tangent of the 4 deg. curves and the 134-ft. spans are on the 10 deg. curves.

Each of the 211-ft. spans is carried by three arched ribs of



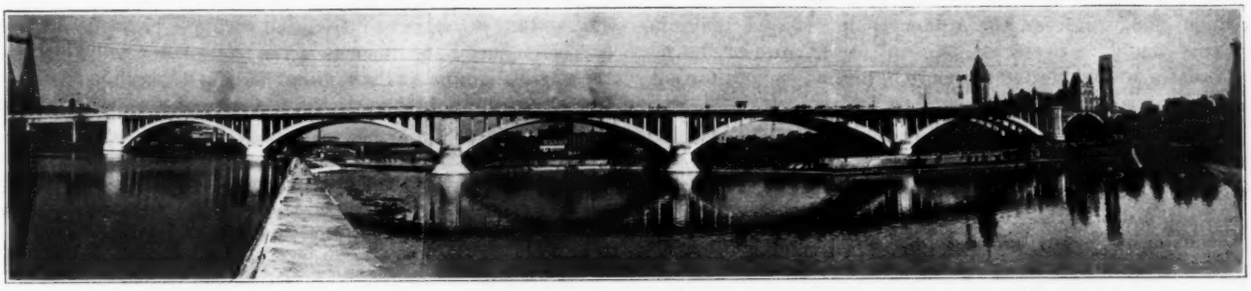
VIEWS OF THIRD AVENUE, SOUTH, CONCRETE-STEEL ARCH BRIDGE, MINNEAPOLIS, MINN. UPPER—SPANS 8 AND 9 SHOWING TRANSVERSE WALL FORMS AND FLOOR SLAB FORMS. MIDDLE—PERSPECTIVE VIEW SHOWING LAMP POLES, BRACKETS AND TWIN CABLEWAY TOWERS. CLEAR SPAN OF CABLEWAYS 2,036 FT.; MAX. LOAD PER CABLE 10 TONS; WORKING LOADS 6 TONS. LOWER—TOP VIEW OF STRUCTURE SHOWING CURVATURE ALIGNMENT.

36-ft. rise, of reinforced concrete. The outside ribs are 12 ft. wide in the two end spans and 10 ft. in the intermediate spans, while all center ribs are 16 ft. wide. The reinforing is of the Melan type, consisting of ribs 4x4x4½-in. angles laced with 3x3x$\frac{5}{16}$-in. angles (at haunches) and 2½x⅜-in. bars. There are six of these ribs in each 16-ft. arch rib, five in the 12-ft. and four in the 10-ft. ribs. They are braced every 30 ft. with 3x3x$\frac{5}{16}$-in. angles. The two 134-ft. spans over the east channel are full-barrel arches with Melan ribs of 3x3x$\frac{5}{16}$-in. angles laced with 2½x¼-in. bars. These are spaced 34 in. c. to c. and cross-braced every 30 ft. with 3x3x⅜-in. angles. Carrying the floor system from the ribs are transverse walls and girders supporting the floor slab and brackets supporting the sidewalk slabs and parapet-wall beam. Air was used for riveting.

The grand total cost will be $800,000. The bridge will require 56,000 cu. yd. of concrete, 963 tons of structural steel for the arch ribs, 800 tons of reinforcing bars for piers and 1,600,000 ft. of lumber for centering. The prices for materials delivered at the site were as follows: Crushed traprock, $1.45 per cu. yd.; washed sand, 75 cts.; cement, $1.20 per bbl.; structural steel (including erection bolts and nuts), $53.50 per ton; reinforcing bars, $1.429 per 100 lb.; Lackawanna 7-in. steel sheetpiling, $1.63¾ per 100 lb.; coal (lump), $4.15 to $4.25 per ton; electric current for light and power, 2.9 cts. per kw.-hr.

Personnel.

The construction of the bridge is being done by the City of Minneapolis under the day labor plan and, as is the case with all of the City Work, is under the direct charge of the City Engineering Department.



VIEW OF THIRD AVENUE, SOUTH, CONCRETE-STEEL ARCH BRIDGE, MINNEAPOLIS, MINN.

The original sketches and studies as well as all the used surveys were made by the Concrete-Steel Engineering Company of New York who also drew up the full detail plans and the specifications, and supervised the construction. Mr. William Mueser, Mem. Am. Soc. C. E. is directing head of this company. Mr Henry Hornbustel was the consulting Architect and Mr. Chas. F. Bornefeld C. E., the resident engineer on the work for the Company.

The construction forces were under the direction of the City Engineer, Mr. Frederick W. Cappelen, Mem. Am. Soc. C. E. with Mr. Wm. Elsberg, Assistant Engineer and John Lundstrum general foreman. The City Engineer also had the general direction of plans and the supervision of the structure was performed under his general direction.

The early spring is now being designated as the time for completion and for opening the bridge to traffic. There still remains some 2,000 cu. yds. of concrete to place and the wood block pavements and sidewalks to lay.

WATER PURIFICATION AND SEWAGE TREATMENT

Some Conclusions Reached at Milwaukee on Treatment of Sewage by Activated Sludge Process

In the activated sludge process as in all other methods of sewage treatment, the character of effluent required is one of the first questions to decide, for upon it depends the size of plant and the air required to operate it.

If the removal of the matters in suspension and the production of a clear effluent are all that are required, less aerating tank capacity and less power should be provided; whereas, if the effluent must be not only clear but well nitrified, the sewage must be given a longer period of contact with the air and sludge and a greater volume of air per gallon of sewage treated must be used.

In an aerating tank having 15 ft. effective depth of liquor 98% removal of suspended matters can be effected with .5 cu. ft. of air per gallon of sewage treated applied for one hour. On the other hand if nitrates are to be produced in the effluent the same sewage will require from .75 to 1.10 cu. ft. of air per gallon applied from four to six hours.

The cause of this result is that the agitation of the liquor by the air separates the solids and collodial matters very rapidly but it takes time for the bacteria contained in the activated sludge to convert the ammonias into nitrates and these in turn to nitrates.

Preliminary Processes Desirable

Should the sewage to be treated be combined with storm water, grit chambers should be installed of such a design as effectually to exclude from the aerating tanks all grit.

The sewage from an industrial community collected either by a separate or combined system of sewers should be fine screened before passing into the aerating tanks.

Grit in the aerating tanks settles to the bottom and rests upon the air diffuser plates, interfering with their efficiency. All industrial sewage carries quantities of waste, fleshlings, pieces of leather, packing house wastes, large pieces of paper and textiles of many kinds, lime and hair. When in the aerating tanks these things form masses of great specific gravity, settle upon the diffuser plates and interfere with their efficiency. If they are carried over to the sedimentation tanks they frequently stop up the sludge draw off pipes and valves and thus disturb the continuous operation of the plant.

In addition to the above objections, the decomposition of

the organic matter contained in these articles requires large quantities of air, which is a more expensive media than can be utilized in other forms of sludge reduction. We found at Milwaukee by means of experiment that we could save from 15% to 20% of air when treating sewage passing through a 20-mesh screen as compared with the same sewage passing through a 1-in. grid screen.

Where a purely domestic sewage is to be treated by the activated sludge process, the author is not so sure that fine screening would be necessary. In any case, however, he believes that a 3-16-in. slotted screen is quite fine enough for any character of sewage.

Type of Aerating Tank

Local conditions will largely influence type of aerating tank. The size of the plant may also have its effect upon the design. In order to reduce construction cost, simplicity of design should be closely adhered to. After determining the period of retention in the aerating tank and the volume of liquor to be treated the tank should be proportioned to give the greatest length of flow possible without wasteful use of piping and concrete.

The greatest length of flow tends fully to utilize the law of average in tank efficiency. For instance, if a tank is 100 ft. long and 22 ft. wide having 17 rows of diffuser plates spaced about 6 ft. centres across the axis of the tank it will have a greater efficiency than one 50 ft. long and 44 ft. wide with 8 rows of diffuser plates, because in passing thru the first tank the liquor must pass twice as many air baffles as when passing through the last tank and the changes of direction will be correspondingly increased. In the last named tank more efficiency could be obtained by dividing it into two separate compartments by a central baffle wall, applying and taking off the liquor at the same end.

Our tanks in Milwaukee are to be 350 ft. long and 22 ft. wide, the liquor being applied at one end and removed from the other.

Piping

The piping system of the activated sludge process being an expensive feature, due attention should be paid to it in the design. All valves should be placed so as to be easily reached, and all air piping should be of such a type as to preclude inside corrosion. Iron rust gets into the pores of the air diffusers and reduces their efficiency. Therefore, cast, galvanized, or Sherrardized iron pipe or lead should be used for conveying air thruout the plant.

The bottom of aerating tanks should be of saw tooth, or similar form, with slopes of from 1 to 1 to 1 to 1.5, with the air diffusers placed in the gutters. The object is to allow no flat places upon the bottom upon which sludge could rest and become septic.

The air diffusers may be placed in cast iron or concrete containers, preferably the latter, both on account of less cost and no tendency to corrode. If cast iron containers are used they should be given a good coat of pitch while hot, care being taken to place the diffusers in the containers in such manner as to secure air-tight joints and permit of their removal and replacement without damage.

Type of Sedimentation Tank

Sedimentation has been given greater study at the Milwaukee Testing Station than any other feature of the process. Many different types of tanks have been operated for the purpose, primarily, of determining the best type of tank, flowing thru velocity, area, depth and sludge removal. Without going into the minute details of these experiments, it will perhaps be sufficient to state the general conclusions warranted by these experiments.

The running through velocity should not exceed three feet horizontal per minute. The detention period may be from thirty to fifty minutes according to character of sewage treated. Vertical-horizontal flow is more efficient than vertical or horizontal.

The effluent must be removed with the least velocity possible and over continuous rather than V-shaped wiers. The latter cross-currents just when they are most objectionable. Cross-currents must be avoided so far as possible.

The influent must be introduced back of a baffle at least four feet below surface of liquor in tanks. The flow should be across the narrow section of the tank. Too long a depth of flow tends to pick up the lighter particles of sludge and carry them over with the effluent.

A baffile should be placed back of the effluent wier extending a few inches below the liquor surface: This is to prevent the fats, match sticks and other light substances, which float upon the surface of the liquor, from passing out with the effluent.

The depth of the tank is not material except that it shall be sufficient to allow capacity for the settled sludge to be drawn off without abnormally increasing the under-currents near the level of the bottom of the influent baffle due to the suction of sludge passing from the tank.

An area of 1 sq. ft. for each 1,600 gal. of well aerated sewage should be provided. The less the aeration the greater the area required.

The tanks may be either hopper or flat bottom, as desired and the sewage may be removed by air lifts or hydrostatic pressure. If hopper bottom the slopes must be from 1 to 2 to 1 to 3 to keep the sludge moving towards the draw off pipe.

If the flat bottom is used some apparatus must be provided to remove the sludge settling on the bottom to a draw-off pipe. This may be done by a Dorr thickener, or similar device, or by a squeegee mechanically operated from the top of the tank.

In the Milwaukee Station the last two mentioned devices have been tried out with satisfactory results. They insure a clean tank, thicker sludge and less tank depth. Returning thicker sludge to the aerating tanks means reduction of air.

In localities where deep tanks would greatly add to expense of construction, the mechanical devices above mentioned would probably be advisable.

Type of Air Diffusers

Several types of air diffusers have been tried out at the Milwaukee station, prominent of which are field tile, thin wood blocks cut cross-grain, perforated pipes and filtros plates of different porosity.

Filtros plates as manufactured by the General Filtration Company of Rochester, N. Y., are porous plates 1½ in. thick made up of graded sand and burned in kilns under high temperatures. They can be made of any degree of porosity required, are stable in character, and are, by all means, the most satisfactory air diffusers we have used at Milwaukee.

Ratio of Air Diffuser and Tank Surface

Ratios of from 1 to 4 to 1 to 10 have been used in United States and England. The latter inclines towards the greater ratios. It is the author's opinion that the economical ratio largely depends upon the type of aerating tank used and the character of effluent required.

In a short flowing through length a ratio of 1 to 4 or 1 to 5 would prove more efficient thus decreasing the tendency of short-circuiting the passing liquor; whereas in long flowing through tanks a greater ratio could well be used because the law of averages are thus better utilized.

The higher standard effluent required the smaller the ratio, for the same reasons as above stated. The author has de-

termined to use a ratio of 1 to 6 in the Milwaukee plant, where the tanks are 350 ft. long and must produce a high standard effluent.

Period of Aeration

This factor largely depends upon the character of sewage to be treated and effluent to be produced.

A mixture of domestic and industrial sewage can be well clarified, that is, to contain not more than 5% of the suspended solids in the original sewage in one hour's aeration by using from .5 to 9. cu. ft. of free air per gallon of sewage treated. To maintain this clarification, however, it is necessary to further aerate the sludge removed from and returned to the aerating tanks.

This proceedure, however, saves air because the sludge aerated is only 1/3 to ½ of the total volume of sewage treated.

To produce an effluent containing nitrates and from four to six parts of dissolved oxygen, with a reduction of bacteria of from 95 to 98%, from the character of sewage named, requires from four to six hours aeration. After such period of aeration there seems to be little or no advantage obtained from re-aerating the sludge, probably because it is maintained in prime and active condition by the period of aeration above stated.

Period of Sedimentation

The period of sedimentation is closely connected with the period of aeration, assuming the sewage treated to be of similar character. Low period of aeration requires longer period of sedimentation.

Well activated or well aerated sludge flocs very rapidly and settles out of the liquor at the rate of one vertical inch per minute, whereas poorly aerated sludge flocs slowly; in fact, the finer particles seem incapable of flocculating.

While the period of sedimentation is a factor to be considered, the principal factor seems to be the area provided, as has already been mentioned.

From 30 to 50 minutes are sufficient to clarify the sewage providing the sludge is removed from the sedimentation tank as rapidly as it settles.

Volume of Air Required

The volume of air required depends upon several primary factors, such as the character and quantity of organic matter in the sewage, depth of aeration tanks and the character of effluent required. To some extent the temperature of the sewage below 50 deg. F. also has its influence if continued over a long period.

Inasmuch as the chief expense in operating the activated sludge process is the cost of the power producing the air the quantity required should be carefully determined in each case and the entire plant designed and operated with a view of reducing the air consumption to the economic limit.

The author is of the opinion that the Milwaukee sewage can be successfully treated to produce an effluent showing 90% removal of bacteria, 95% removal of suspended matter and 72 hours stability by using 1.5 cu. ft. of air per gallon of fine screened sewage in a 10-ft. deep tank, and 1.1 cu. ft. of air per gallon in a 15-ft. deep tank using from 15 to 25% of activated sludge in the aerating tank. Screens to have from ⅛ to $\frac{3}{16}$-in. slots.

Percentage of Activated Sludge

This factor is not a very important one within certain limits. We have obtained equal results when using 15% to 25% of activated sludge in the aeration tank. Indeed it is quite fortunate that this is true, for without extremely close supervision it is impossible to maintain an uniform percentage of sludge in the plant.

About 20 percent of well activated sludge is all that is required for satisfactory treatment. This percentage is measured in a beaker after one-half hour's settlement, after which the settled sludge contains about 99% of moisture.

Volume of Sludge to Be Handled

Of course this factor largely depends upon the suspended matters in the raw sewage and the period of aeration given. As stated immediately above the volume of sludge fluctuates very much and averages only can be considered.

Basing our assumptions upon experiments we are providing in our final plant at Milwaukee to produce from each million of gallons of raw sewage treated 55,565 gallons of sludge containing 99.5% moisture, 10,250 gallons containing 98% moisture, 8,305 pounds of pressed sludge cake containing 76% of moisture, and 2,076 pounds of dried sludge containing 10% moisture.

Removing Sludge From Sedimentation Tanks

Several methods have been carried out in Milwaukee for removing the sludge from the sedimentation tanks.

It is the author's opinion that the removal of the sludge by mechanical means will largely reduce the first cost of plant and produce a much more satisfactory and uniform effluent. While pumping the sludge by air increases to some extent the oxidation of the sludge and maintains it in a well fluctuated condition, the expense over pumping with centrifugal pump overcomes these advantages.

Value of Sludge

Estimating one ton of dry sludge can be obtained from one million gallons of raw sewage treated, and an average daily dry weather flow of 85,000,000 gallons, the net cost of disposing of Milwaukee's sewage is estimated at $9.64 per million gallons, of which $4.89 is chargeable to overheads, and $4.75 to operation, renewals and repairs. The 85 million gallons of sewage per day is expected to be produced from a population of 589,000 and the net cost of operation including overheads and maintenance, is 53 cts. per capita.

Elimination of Odors

There is no offensive odor connected with the activated suldge process of sewage treatment, but considerable odor may attend the improper methods of sludge reduction.

Partially dewatered sludge, if exposed to the sun for a few hours, gives off a highly objectionable odor of sulphuretted hydrogen. This odor lasts for a short time only, or until a dry covering is formed. Sludge placed under cover and not exposed to sun or wind gives off but little odor.

In drying the sludge through a direct heat dryer a very offensive odor is thrown off with the hot gases of combustion. To overcome this effectually the gases must be run through a dust box, thence through a condenser, and the insoluble gases escaping from the latter should be discharged into a furnace immediately under the fire grate.

Neither flies, insects nor worms inhabit the treatment plant even during the early fall when they are so prevalent in nearly all other types of disposal plants.

Conclusions

The foregoing statements have been made as the result of observations and studies of the operation of the sewage testing station at Milwaukee covering a period of three years, during the last half of which has been almost exclusively confined to the activated sludge process.

The author feels that while there are many phases of this process yet to be determined which can be done only after operating a large plant, the important factors which influence the adoption and design of the plant have been proven.

In situations which require a high standard effluent the most satisfactory process in use today is sedimentation followed by percolating filters. The separate features of this process have been developed from year to year during the past decade

until it may be said that it has reached its limit. Even so the sludge problem has not been satisfactorily solved where large plants are to be considered, inasmuch as the constant accumulations of partially dried and half decomposed sludge is bound to create in the future a nuisance difficult to handle in a sanitary manner.

The only other process known to the author which can produce an effluent comparable with percolating filters is the activated sludge process, which, when developed to the extent possible and very probable within the next decade, will doubtless supersede the filters.

There are many advantages in this new process which must be considered, among which are small area, lower first cost, and final disposition of the troublesome sludge.

As compared with percolating filters treating a maximum rate of 3,000,000 per acre under favorable climatic conditions the activated sludge process can treat 10,000,000 gallons per acre under the most unfavorable climatic conditions.

The first cost of construction is more for the percolating filters than for the activated sludge process, and little difference is expected in the cost of operation.

The Milwaukee plant, as designed, is estimated to cost $44,000 per million, exclusive of engineering and pumping, and $4.75 per million gallons operating cost. This first cost embraces prices for labor and material which did not prevail when the percolating filters above alluded to were built.

Mr. E. E. Sands, City Engineer of Houston, Texas, has just completed an activated sludge plant, (exclusive of sludge disposal) to treat 12 million gallons at a cost of about $24,000.00 per million, and expects to install the sludge disposal features for $40,000.00, the balance of his appropriation.

The high nitrogen content in the sludge produced from the activated sludge process warrants the expense necessary to reduce it to a fertilizer basis, and thus the sludge problem is effectually solved without nuisance.

The absence of odors, flies and other insects is no small advantage. The former advantage frequently enables the engineer to eliminate long expensive outfall sewers. The small loss of head through the process frequently obviates pumping as is so often required in the percolating filter process.

Throughout many of the discussions between engineers relating to this new process the cost of power has been one of the stumbling blocks. In a small plant treating less than five million gallons per day the cost of producing the power might prove too expensive, but where larger plants are under consideration power can easily be produced for less than one cent per horse-power hour. Such a cost will make the cost of operating the process upon an equality with the percolating filters.

Acknowledgment

The foregoing matter is from an address to the American Public Health Association by T. Chalkley Hatton, Chief Engineer, Milwaukee Sewerage Commission.

REFUSE COLLECTION AND DISPOSAL

Recommended Methods for the Collection and Disposal of Refuse in Louisville, Ky.

By Samuel A. Greeley, Hydraulic and Sanitary Engineer, 64 W. Randolph St., Chicago.

The recommendations here made are the result of field inspections made in Louisville by the author and Frederic Bonnet, Jr., of Worcester, Mass., who was secured as special assistant on this work. The report was made to and paid for by the Woman's City Club of Louisville, Ky.

The refuse materials, whose treatment is considered in the report, are: Garbage, ashes, rubbish, tins and mixed refuse. The treatment of stable manure was the subject of special report.

Four Parts of Refuse Disposal Problem.

There are four equally important parts or phases of the refuse disposal problem, as follows:

a—The so-called "House Treatment," which includes the degree of separation, the type of house can, the location of the can and such other items relating particularly to the work of the householder.

b—The "Collection" is the various materials.

c—The "Secondary Transportation" of the refuse materials after they are collected and delivered to one or more central points.

d—The "Final Disposal" of the refuse after collection and transportation.

All of these parts are equally important, but the collection is most costly. In the solution of the refuse disposal problem due consideration should be given to each phase, so that each one will co-ordinate with the others. In fact, the most important element in the refuse disposal problem is the development of a complete system, starting with the ordinances and continuing through the house treatment, collection, transportation and disposal. Many different methods of refuse disposal are in successful operation in various cities. The extent to which the service is satisfactory to the householder, however, depends upon the completeness with which the service as a whole is developed and operated.

VIEW OF WELL-KEPT REFUSE DUMP IN ST. LOUIS, MO.—NOTE RESIDENCE IN DISTANCE.

Efficient Operation Essential.

The operation of refuse collection and disposal work is of such importance as to warrant a special comment. A refuse

disposal plant is not of itself a proof against odors and nuisances. Faulty or careless operation will result in more or less odor in any plant. Unclean wagons will largely defeat an otherwise well planned system. Improper house treatment will make it difficult and some times impossible for the collection service to maintain each district in a clean and sanitary condition. Therefore efficient management and operation is essential.

House Treatment and Collection.

It is a common experience to find public attention directed first toward the method of final disposal. It is to be questioned, however, whether this phase is relatively as important as the house treatment and collection. On a cost basis the collection is the most important. From the aspect of neighborhood cleanliness and comfort, the house treatment is of considerable importance. A fair conclusion is that each of the four phases of the problem are important and should be given equal consideration. The four phases are so closely associated with each other that a lack of proper coordination materially reduces the efficiency of the service and at the same time increases the cost.

Louisville Data.

Louisville has an area at present of 26.9 square miles. The larger dimension, in an east and west direction is about 8.0 miles, while north and south the city extends about 3.5 miles. The present estimated future population is as follows:

1910	225,567
1917	240,000
1920	255,000
1930	300,000
1940	345,000

We have estimated at present about 55,000 houses in the city. The city is built for the most part on rolling ground above the Ohio river, with a maximum rise over the river of about 160 ft. The population is comparatively compact at about 13.9 per acre. The city is comparatively well paved, containing 240 miles of pavement out of something over 300 miles of streets.

The present total assessed valuation of Louisville amounts to about $211,000,000. The outstanding bonds amount to $12,391,500, or about 6.0 per cent. of the valuation. Additional bonds up to 4.0 per cent. of the valuation, or about $8,000,000, could therefore be issued, if given a favorable popular vote, and provided the annual revenue could be increased sufficiently to meet the interest and sinking fund requirements.

Present Collection and Disposal Methods.

The collection and disposal of refuse in the City of Louisville is at present handled by the Board of Public Works, through the superintendent of the Street Department. Mixed garbage, ashes and rubbish are placed by the householder in the same receptacle and these receptacles are set out on the sidewalk for the collector. Collections are made in wooden wagons, drawn by two horses and served by two men. The refuse so collected is hauled to twelve dumps, scattered throughout the city. The ordinances covering this work are complete and do not bear directly on the refuse disposal problem.

Each dump has a dump boss, whose duties are to oversee the dump, sign tickets for wagons and direct the wagons where and how to dump. These dumps are usually offered the city by property owners who wish to have their property filled. The dump boss makes arrangements with scavengers for their help in covering the dump, as compensation for which they receive certain picking privileges. Bread, clothing, bottles and other marketable articles are picked out in this way. During July, 1917, there were about 600 hogs running loose on the various city dumps and feeding on the garbage contained in the refuse.

Some attempt is made to cover and level the dumps with dirt and street sweepings, and at times carbolic acid and creosote are used to reduce the fly nuisance. These dumps, however, are not maintained as well as they should be.

Data Gathered in Field Investigations.

Under our direction a substantial amount of field investigations have been made. As regards house treatment, it was found in the district studied that 17 per cent. of the receptacles set out were cans, the remaining 83 per cent. being barrels, baskets, pails and other various vessels.

At 43 per cent. of the houses visited the collections were made once a week and at 33 per cent. of the houses twice a week. The three times per week collection reached only 24 per cent. of the houses.

Out of a total of 495 collections observed 371, or 75 per cent., were from receptacles set out on the curb. The receptacles were set out for the collector with great regularity, but not as

FLY CAGES AT GARBAGE BURIAL FIELD, WORCESTER, MASS.

frequently as might be. The wagons were available for more frequent collections. The records indicate that the collectors quite frequently went into the back yards for the receptacle.

Time Studies.

Time studies were also made of the work of the collection wagons. Wagons are able to make from 4 to 6 loads per day. The actual time loading amounts to about 27 per cent. of the total working time, the remaining 73 per cent. being spent in hauling and unloading. This data points clearly to the advisability of using larger wagons to reduce the number of trips per day, and thus to reduce the unproductive time spent hauling and to increase the productive time in actual collections. The average time per collection was 22 seconds, which was very rapid. The average number of houses visited per wagon per day is about 225, which could be increased by the use of larger wagons.

The dumps were not sufficiently trimmed and covered. There was too much uncontrolled scavenging and hogs were allowed to run loose. The result was most unsightly. Many flies developed, but odors were not pronounced during our inspections.

The available records of the number of wagon loads of refuse collected each day since the year 1910 have been secured and tabulated. On the basis of an average weight per load of 1,200 lbs., these records indicate a production of mixed household refuse of 825 lbs. per capita per year. Based on Louisville conditions and on comparison with refuse quantities

in other cites I have estimated the quantities of refuse which will have to be handled in Louisville as given in Table I.

Table I—Estimated Quantities of Refuse to Be Handled.

	——Tons Per Day——			
	1920		1930	
Material.	Average.	Maximum.	Average.	Maximum.
Garbage	72	108	80	120
Ashes	238	380	280	450
Rubbish	33	40	40	48
Mixed Refuse	343	446	400	520

The estimate given in Table I should be checked up by taking actual weights of the refuse as now collected over a period of about a year.

There is a marked seasonal variation in the production of these refuse materials which it is necessary to consider in the planning of the refuse disposal system. Louisville refuse appears to be somewhat lower in quantity per capita than in other cities located to the north, where accurate weight records are kept. In my opinion the garbage will run slightly below the average in its content of grease and tankage and the mixed refuse will have a comparatively high calorific value.

No study of the refuse disposal problem can be carried out thoroughly unless the principles of the problem are appreciated. A comparison of the various methods of refuse disposal must include all the factors and phases involved and a balance struck on both sanitary and economic lines.

The frequency of collection depends largely on the funds available. To give service three times per week will cost about 50 per cent. more than to give service twice a week. The first cost of refuse disposal is largely dependent upon the method of disposal and the annual cost upon the amount of collection service rendered. The cost of the house treatment is controlled by the number of cans required, and comes directly upon the householder.

Recommendations for Upkeep of Dumps.

In view of the present method of disposal by dumping in Louisville special recommendations have been given for the upkeep of dumps. Some classes of refuse are more easily disposed of by dumping than others. These are ashes, street sweepings, building excavations and other more or less inert materials. Large quantities of such materials will be disposed of in this way. Garbage is objectionable on dumps because of the number of flies and rats that are produced. Under proper direction rubbish may be safely disposed of on dumps. In cities having a large number of low places it is desirable to use some of the refuse for filling.

Among the special requirements for the upkeep of dumps are the following:

a—The dump should be filled so as to limit the dumping edge as far as practicable. The exposed edges are the most objectionable because of the difficulty of covering them.

b—A sufficient amount of ashes, street dirt, building excavation or borrowed earth should be secured to properly cover and level the dump.

c—Completed portions of the dump should be seeded and partially parked, as is frequently done (New Orleans, Nurenburg).

d—No scavenging should be allowed at the dump at any time except by city employees.

e—Portable rubbish burners should be kept at the dump to burn large, bulky portions of rubbish not suitable for fill.

f—A water pipe should be laid to each dump to bring water for use in putting out fires and for sprinkling to prevent dust.

g—A sufficient supply of kerosine, creosote or other fly germicide should be kept on hand so that any large number of fly maggots can be killed before developing into flies. In addition fly traps should be kept at the dumps, as done at Worcester, Mass., and here illustrated.

h—Only such garbage as cannot be readily kept separated from other refuse should be dumped.

i—The used portion of each dump should be enclosed with a light movable board fence, to facilitate control and prevent paper dust from blowing away.

j—The dump should be in charge of a uniformed foreman with authority to enforce the regulations.

To carry out these requirements funds are needed, but even with these necessary expenses disposal by dumping is less costly than by other methods.

In accordance with the general discussion of the refuse disposal as given in the report and the special data secured for Louisville, a number of projects for refuse disposal are described in the full report. It should be noted again that the most important feature of any project is the completeness with which it is planned and put into operation.

Estimates of Cost.

The house treatment, collection, transportation and final disposal must all be included and worked out to form a complete comprehensive system. If such a complete system is developed along sanitary lines, the particular method of refuse disposal adopted is not the most important feature. However, the estimates of cost indicate the preferable method of final disposal.

VIEW OF GARBAGE DUMP, LOUISVILLE, KY.

The estimates of cost have been made up on a conservative basis. However, it should be noted that under present market conditions estimates of cost are difficult to make, particularly to hold for any time in the future. Therefore, if construction is postponed for a number of months, closer estimates will be required in conjunction with definite sites. The estimates as given are on a uniform basis and serve for a comparison of the different methods of disposal.

A summary of the estimates of cost of different projects for refuse disposal for Louisville is given in Table II. Three projects have been made up on the basis of complete or partial incineration and three projects on the basis of the reduction of garbage and the disposal of ashes and rubbish by dumping and sorting. The most costly projects on an annual cost basis are those by incineration. These range from $0.98 to $1.08 per capita per year, including operation and fixed charges. The projects for reduction of garbage and dumping of ashes and rubbish range from $0.83 to $1.03 per capita per year, including fixed charges, based on normal prices for grease and tankage. At present market prices the garbage reduction project amounts to $0.61 per capita.

Table II—Estimated Cost of Refuse Disposal for Louisville, Ky.—Summary of Data.

Project. No.	Description.	First Cost.	ANNUAL COST— Oper-ation.	Fixed Charges.	Total.	Revenue.	Net annual Cost.	Net capita annual cost.
I-a:	Mixed collections and Incineration	$539,000	$229,200	$ 52,155	$281,355	$ 31,355	$250,000	$0.98
I-b:	Two separations and partial incineration	320,800	244,100	32,116	276,416	.....	276,416	1.08
I-c:	Two separations and partial incineration	176,800	239,500	18,436	257,126	.....	257,126	1.01
II-a:	Two separations and garbage reduction	331,800	259,960	37,741	279,901	85,600	212,301	0.83
IIb:	Three separations, garbage reduction and rubbish sorting	398,300	317,960	45,328	363,288	100,000	263,288	1.03
II-c:	Two separations and garbage reduction by Cobwell Process	386,800	259,960	45,466	305,426	85,600	219,826	0.86
II-a:	See Above Revenue Figured on present market	.....	.....	.....	.....	143,800	.....	0.61

In view of these estimates given in Table II, I recommend that the city of Louisville undertake a complete refuse disposal system as follows:

a—House Treatment.

Proper ordinances should be enacted to provide for two separations of refuse, so that garbage may be collected in one set of wagons and ashes and rubbish in another.

b—Collection.

Special refuse wagons, adequate to the collection service required, should be purchased and maintained by the city. Teams and laborers can be hired. The wagons should be as large as the district conditions and character of refuse collected permit. Garbage should be collected at least three times a week in summer and twice a week in winter, with daily collections in special districts. If funds permit, more frequent service should be given. Ashes and rubbish should be collected from once to twice a week, as the season and district requires.

c—Transportation.

On the assumption that a garbage reduction plant will be located at some distance from built-up districts, secondary transportation of the garbage is included. The transfer stations should be built for clean and sanitary operation and special freight cars should be purchased.

d—Disposal.

Garbage should be disposed of by reduction and ashes and rubbish by dumping. Sufficient funds should be made available at once for the proper upkeep of the dumps and provision should be made for sorting out by the city of saleable rubbish. This would require a light building for paper baling presses and bins.

Reasons for Recommendations.

The following reasons for these recommendations are noted:

a—The project recommended offers the least costly system of refuse disposal, combined with sanitary operation.

b—Utilization of garbage and the recovery of portions of the rubbish meets with the present National program for the conservation of the country's resources. This is a desirable feature when it results in a true saving.

c—The dumping of ashes and rubbish provides a material for filling up lowlands in the city which areas would not be otherwise readily made available for use and also utilizes this natural asset of the city for economic disposal.

Tentative Working Program.

Pending the securing of funds, the purchase of sites and the construction of plants the following working program is suggested:

a—Make accurate weights of refuse as collected.

b—Prepare and adopt ordinances.

c—Readjust at once the operation and maintenance of dumps to provide sanitary upkeep, while all classes of refuse are thus disposed.

d—Make special tests of refuse wagons to determine the most economical size and design, so that the best equipment may be purchased at the time the new works are ready for operation.

e—Thoroly overhaul the house treatment, so that proper house receptacles will come into use.

f—Select and purchase sites and prepare plans and specifications for a garbage reduction plant and for rubbish sorting on the dumps.

These recommendations provide for an immediate improvement in the house treatment, collection and disposal, together with an opportunity for developing a complete and permanent system for refuse disposal. The City Officials should now continue this work as outlined and take proper steps to have the details of the plan worked out and put into operation.

FROM WORKERS IN FIELD AND OFFICE

Cost of Constructing Brick and Asphaltic Concrete Pavements in Kalamazoo, Mich.

THE EDITOR MUNICIPAL ENGINEERING:

Sir—

The paving engineer is always glad to receive information on the cost of construction in other cities. Very often the costs given are so general that they are not of much value. I hope that these may be of some value to the readers of MUNICIPAL ENGINEERING.

The City of Kalamazoo, Michigan, does all of the construction work in connection with its street paving, except laying the asphalt top on asphalt strets. The City is at present contemplating the purchase of an asphalt plant.

Types of Pavement.

All the work is done under the supervision of the Engineering Department. The two types of pavement having the largest amount of yardage at present are brick for heavy traffic streets and asphalt concrete (Topeka specifications) for residence streets. Both types are laid on a 6-in. concrete foundation. Most of the brick streets are filled with an asphalt paving filler.

Fig. 1 herewith shows men laying hillside brick on South West St. between street car track and curb. Fig. 2 shows a Chain Belt concrete mixer laying foundation on the same street at the foot of the hill.

Cost Data.

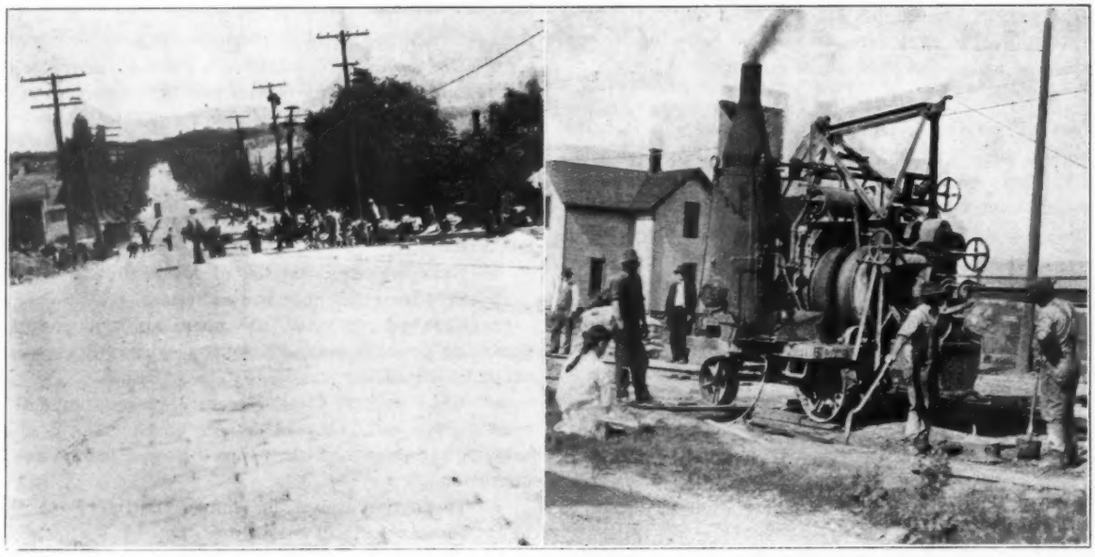
The itemized costs given below are for pavements laid in 1916, for 12,000 sq. yds. of brick laid on two streets, and 20,600 sq. yds. of asphalt concrete laid on five streets. The items given here are averages for each type of pavement. The different total costs on these streets did not vary over three cts. per square yard, so that the average can be taken as the cost for any one street.

The city paid 89 cents per sq. yd. for a 2-in. asphaltic concrete top (Topeka specifications), Bermudez asphalt, with a ten year maintenance guarantee. The city paid $1.36 net per barrel for cement delivered on the street, $17.27 per ton for asphalt filler f. o. b. Kalamazoo; for common labor 25 cts. to 30 cts. per hour, and for teams 56 cts. to 60 cts. per hour.

	—Cents—	
Excavation		22.7
Concrete foundation:		
Cement	21.4	
Gravel	13.3	
Labor	8.7	
Fuel	0.3	
Mixer rent	2.0	
		45.7
Asphalt top (contract)		89.0
Engineering & inspection		5.6
Total cost of asphaltic concrete per sq. yd...		$1.63

A. LENDERINK, City Engineer.

Kalamazoo, Mich.



STREET PAVING VIEWS IN KALAMAZOO, MICH. LEFT—LAYING HILLSIDE BRICK ON WEST STREET. RIGHT—CHAIN BELT MIXER LAYING CONCRETE FOUNDATION ON SAME STREET.

Cost of Brick Pavement Per Square Yard.

	—Cents—	
Excavation		29.5
Concrete Foundation:		
Cement	21.4	
Gravel	13.3	
Labor	8.7	
Fuel	0.3	
Mixer rent	2.0	
		45.7
Brick	86.0	
Unloading & cartage	9.0	
Sand	3.2	
Laying and culling	11.3	
		109.5
Filler	8.70	
Unloading & cartage	0.35	
Pouring	5.30	
Fuel	1.00	
		15.35
Engineering		5.00
Total cost of brick pavement per sq. yd...		$2.0505

The depth of excavation for the brick pavement averaged two feet.

Cost of Asphalt Concrete Pavement per Square Yard.

The excavation averaged one and one-half feet.

Oregon State Highway Commission and Contractors Pleased With Cost Plus Percentage Contracts

The Editor of MUNICIPAL ENGINEERING:

Sir—

There is now before the Oregon State Highway Commission, either under construction or authorized for construction, 42 different projects in the state, approximately $2,250,000 in cost, and in addition to this there are 17 projects covering road construction in conjunction with the U. S. Forest Service, approximating $1,114,000 in cost.

Plans and specifications, advertisments and, in a number of cases, a large portion of the surveys necessary to start these projects have been made by the department since June 4th of this year, when the bond issue was voted.

At the meeting of the Commission on November 6, proposals were received for the construction of 5 miles of highway from Hood River to Mosier (a section of the celebrated Columbia River Highway) which it was estimated would cost $352,000. At the same meeting, proposals were received for the improvement of two very dangerous sections of the Pacific Highway in Douglas County. These are what are known locally as the Roberts Mountain section, nine miles south of Roseburg, and the Wolf Creek-Grave Creek section near the Douglas-Josephine County line. In the neighborhood of $300,000 was the estimated cost of this improvement. With other improvements that are under way, including one very bad stretch on the Pacific Highway in the vicinity of Canyonville in the Umpqua

National Forest, which is to be taken care of by the Forest Service in cooperation with the state, this will make the Pacific Highway practically safe for travel by next season, as this work will be started at once and probably completed by June 1 of next year.

A portion of the work being handled by the department is being done on a force account, plus percentage basis. Owing to the fact that construction work is so greatly affected on the Pacific Coast by war conditions, it has seemed practically impossible for many contractors to find a basis on which to make a unit price proposition, and on the urgent request of a number of these contractors the work was let on the cost plus percentage basis in an endeavor to try out this method of handling construction work for the information of the commission in handling the larger volume of work which will come up during the year 1918. So far it seems to be a very satisfactory method, all conditions being considered, both for the contractor and for the state.

Very truly yours,

OREGON STATE HIGHWAY COMMISSION,

Salem, Oregon. G. ED ROSS, Sec'y.

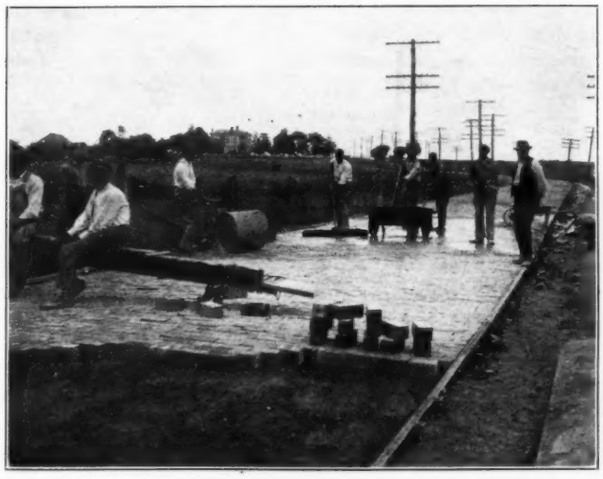
Rapid Progress Made in Laying Monolithic Brick Pavement

The Editor of MUNICIPAL ENGINEERING:

Sir—

The accompanying view shows my gang laying monolithic brick pavement. It will be noticed that there are only three men in the grouting gang following the brick gang. The brick gang has eight men and they used a Mathews gravity brick conveyor. In a 10-hour day this gang completed from 800 to 1,000 sq. yds. of pavement. Another gang laid the concrete base for the pavement. I sublet the contract for laying the brick and grouting from Daniels & Lyst at Anderson, Ind.

This gang of grouters and brick layers is fairly permanent and specializes in laying, rolling and grouting brick for monolithic and cement-sand cushion brick pavements. Using this gang, I take subcontracts for this part of brick paving jobs. The general contractor lays the concrete base and we follow as closely as possible with the brick laying. We take all risk of delays to the concreting gang and the plan has been a money-maker both for us and the general contractor.



ECONOMICAL PLANT AND GANG FOR LAYING BRICK PAVEMENT.

Two men in the brick gang lay the brick and are paid 50 cts. an hour. It is up to the rest of the gang to keep up with the brick-layers. The gravity conveyor helps get the brick to the layers. The grout is mixed in a 2-wheel, flat-bottom trough, which holds a 1-bag batch. Two men mix the grout with hoes and when the mixture has attained the right consistency the mixing box is upended and the entire batch is allowed to run over the brick. The grout mixing box and the mixers are shown in the picture, as is also the man who spreads the grout with a 4-ft. squeegee.

Very truly yours,

Marion, Ind. C. F. GREEN.

Road Building Stimulates Business and Facilitates Its Processes

The Editor of MUNICIPAL ENGINEERING:

Sir—

Our attention has been arrested by a slip from your valuable journal in which you print eloquent comment upon England's slogan, "Business as Usual." In May of this year, when writing on this topic, we urged special support of "Unusual Business"—business that would conserve the resources of the nation at war—business that would produce food and clothing for the soldier and the citizen who supports the soldier—business that would prevent waste by converting the waste into useful products—business that should employ 100 per cent of available labor at wages that would insure the laborer a good living and something left to lend to the government in its need—business that would build dams to produce electric energy to turn the wheels of industry—business that should build railroads and keep them busy, construct docks and elevators, ships and canals, and substantial roads everywhere.

Present Importance of Permanent Roads

Of all forms of construction, none seems to us to be of greater importance in this national crisis than permanent roads and pavements. The building of roads represents an assembling of labor and materials in a structure which, when put to work, will serve the purposes of the nation in both its military and industrial activities for many years to come.

The demands of traffic and of sanitation make city pavements an imperative necessity. Improved roads in the country bring better educational advantages for the farmer boys and girls. Good roads and good schools are the two institutions on which we must largely depend for whatever success we have in perpetuating the principles of democracy upon which our forefathers founded the nation.

Good roads facilitate the transportation of products. The farmer uses his own road over which to reach his market, or rail, or water transportation, a hundred times to any one time of any other means of transportation. All his marketable products must pass on wagons or motor trucks over the highways. A permanent roadway permits him to haul double what he could over a poor road, thus enabling him to market a crop in one-half the time, or it places him one-half the distance nearer the market. Distance is now measured in time and not in miles.

President Wilson on Good Roads

President Wilson has said in one address: "It is perfectly obvious that you have got to have an intricate and perfect network of roads throughout the length and breadth of this great continent before you will have released the energies of America. Good roads are necessary for every practical aspect of our lives, to draw neighborhoods together, to create community feeling, to create those arteries which may be compared to the arteries of the human body."

On another occasion he said: "I should regret to see any instrumentality neglected which has proved serviceable in stimulating business and facilitating its processes. This is not only not the time to allow any slowing up of business, but is a time when every sensible process of stimulation should be used."

The Portland Cement Association has exercised its influ-

ence, through its many representatives in all parts of the country, in an effort to steady the situation, and it now appears that our efforts, added to yours and to those of many other earnest and patriotic business men, have brought to the country a more favorable business outlook, and we hope we have by this pull all together done our bit up to this time in the battle for democracy.

Very truly yours,

George A. Ricker,
Highway Engineer.

Chicago, Ill.

Quincy, Ill., Concrete Pavement in Good Condition

The Editor of Municipal Engineering:

Sir—

The South Twelfth street concrete pavement in Quincy has been down for about three years, and has been subject to both heavy and light traffic. As yet it gives no sign of wear or cracking.

This stretch of paving is 1,412 ft. long and is 11 ft. wide on each side of a car track. It is a one-course pavement, 6 in. thick, of 2:4:6 mix. The paving between the street car rails is of brick, with a cement filler. The brick also extends 18 ins. outside the rails. The cost of the concrete pavement was about $6 per cu. yd.

The pavement has ½-in. expansion joints every 25 ft. It has held up exceedingly well.

Very truly yours,

G. L. Grieser,
Assistant City Engineer.

Quincy, Ill.

Notes on Meter Settings and New Construction at Lansing Water Works

The Editor of Municipal Engineering:

Sir—

We are installing all residential meters in meter boxes at the curb line. We are using a Ford meter box of the "Wabash" type, 15-in. inside diameter for ⅝-in. meter setting and 18-in. inside diameter for larger meters. We make our own concrete tile and figure that an installation complete with ⅝-in. meter, meter box, tile, pipe fitting, and labor, costs us $11.50. We have installed approximately 2,500 of such installations per year for the past three years.

The results received have been very satisfactory, as this type of setting eliminates waste between the curb cock and the house, eliminates not-at-home reports from meter readers and the meters are not subject to tampering by the consumer.

Last winter our freeze-ups in meter boxes were less than one hundred. While a very small portion of our meters are located in cellars, we had almost an equal number of meters frozen in cellars.

It is just possible that a larger diameter tile for the ⅝-in. meter would eliminate nearly all possibility of freezing.

The writer has suggested to a number of meter men that they make a bottom connected meter for the meter box setting, which would greatly increase the distance between the riser pipes and the wall of the meter box, at which point we experience freezing in nearly every case.

One of the 3,500,000-gallon reinforced underground concrete reservoirs is practically completed, and the excavation is nearly completed for the second reservoir. These reservoirs were designed by Major Dabney H. Maury, consulting engineer, Chicago.

The improvements at the pumping station are as follows: The concrete work is practically all completed. The 10,000,000-gallon Snow engine is set up on its foundation. The 5,000,000-gallon Holly engine is on its foundation. The 3,000,000-gallon Alberger two-stage centrifugal motor-driven unit is ready for installation. The two 750-h.p. Sterling boilers are being erected. The 9x200-ft. Alphons Custodis Chimney Construction Co. radial brick stack is completed, and we expect to have the building enclosed within the next thirty days.

The new system being installed consists of large diameter deep wells, approximately 20-in. in diameter by 400-ft. deep, each well to be equipped with deep well pumps, likely of the multiple stage turbine type, which deliver water under low head to the two 3,500,000-gallon reservoirs. From there the water is taken by the high-duty pumping engine and distributed to the distribution system. Our present system consists of five pumping stations with electrical drive pumps, taking their water from the ground by suction, and delivering the same direct to the mains. With the rapid growth of the city, the recession of static head in the wells has made this plan of securing water inadequate for the needs of the city.

Our water works improvements now under construction will cost about $200,000.

Very truly yours,

Board of Water and Electric Light Commissioners,
Guy G. Crane, Manager.

Lansing, Mich., Nov. 2, 1917.

Plant Units and Lay Outs

Features of a Portable Air Compressor

Telephone, gas, water and sewer pipe layers find rock in many of their trenches. The accompanying illustration shows a telephone company using one of the No. 2 Schramm outfits drilling 4-ft. holes. It is not unusual for one man to drill as high as 125 ft. of holes per day. It is possible to drill with this outfit 10 times as fast as drilling by hand, and the compressor operating steadily all day will only use about 3 to 4 gals. of gasoline.

For air supply on larger jobs it is often very convenient to use a series of smaller units. Contractors, ditchers, excavators and others who have rock drilling to do, as well as structural iron workers, cannot always arrange their work so that one compressor unit will do all the work.

On most jobs the demand for air is comparatively light at the beginning. For this work one of the Schramm units can be used. This gives 24 ft. of air and weighs 1,200 lbs. This makes it an easy machine to get on and off the job and at the same time will handle all the ordinary tools, such as rock drills, riveters, etc. As the job progresses an additional outfit can be added. This makes the cost of doing the work lower than it would be if the machine were operating all the time. No engineer is needed. The machines are simple to start and need no further attention. The fuel expense is low, it is claimed.

A feature not to be overlooked is the question of weight. The three 24-ft. units weigh 3,600 lbs. The regular 80-ft. unit weighs close to 8,000 lbs. This means that in the first case no

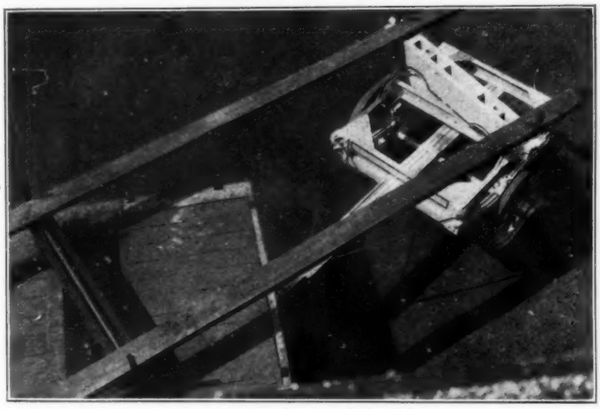
horses are required to move about the 1,200-pound units. They can be set anywhere on the edge of the curb or close to a ditch or excavation. Either one, two or three can be operated, depending on the kind of pneumatic tools being used. If some part of the work away from the main job requires air, then one or more units can easily be put to work on that part.

USING PORTABLE AIR COMPRESSOR FOR DRILLING IN TRENCH BOTTOM.

The unit system of compressed air outfits is being used by structural steel workers, contractors, quarries, mine operators and others. They realize that all their jobs do not require a large, cumbersome machine. They also know that on every job, no mater how large, can be handled with the unit compressors. It is being done with concrete mixers, pumps, hoists and other equipments.

A Special Trailer for Pipe Hauling

A special trailer, of Warner manufacture, for pipe hauling is here illustrated. These trailers are now built in two capacities, Model D-10, 3,500 lbs. capacity; Model D-20, 5,500 lbs. capacity. These capacities are rated for the trailer itself. A 3-ton truck in conjunction with the Model D-10 will handle a



A TRAILER FOR HAULING PIPE.

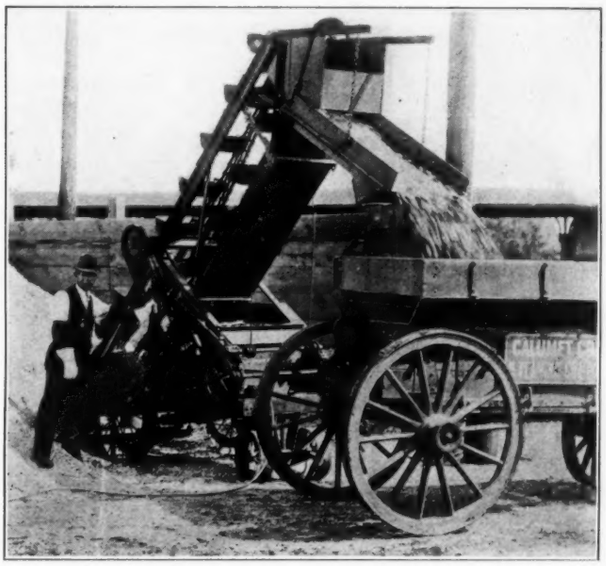
5-ton load, the trailer practically operating only the overhang of the load.

The manufacturers have shipped better than 100 of these trailers into the oil fields of Oklahoma within the last two months. They are principally used for hauling oil casing in 25 to 30 ft. lengths and are also used for hauling miscellaneous other material. They have been successful and are built so they will stand the hard abuse they will receive in that line of work.

A Self-Feeding Bucket Loader

The particular features embodied in the Barber-Greene loader are: Large capacity for handling heavy materials in quantities; minimum labor in operation; easy removal from one position to another. It is self-propelled and has two speeds. One operator handles it. It handles a cubic yard per minute and has a 5-ft. digging width. It is suitable for handling crushed stone, sand, gravel, coal, etc.

It is the only machine of its type, it is claimed, which has been developed for handling heavy, loose materials in quantities and which can handle a large capacity without requiring a gang of laborers to feed the buckets. The rotating discs at the base elevator give an effective digging width of 5 ft.,



SELF-FEEDING BUCKET LOADER IN OPERATION.

which otherwise would be no greater than the width of the buckets themselves. A further advantage of these discs is that the buckets are able to dig off of a smooth surface rather than out of the pile and consequently the power consumed by the discs themselves is made up by the better digging action of the buckets.

The general construction of the machine is arranged to get the necessary advantages from the disc feeder. It is provided with forward and reverse speeds which provide the best operating conditions on the job and also with speeds suitable for moving from one job to another as required.

Gun Mounted on Corduroy Traction a Feature of Milwaukee Liberty Loan Parade

The accompanying illustration shows a "42-centimeter gun" mounted on Pawling & Harnischfeger Co. corduroy traction as it appeared in the Milwaukee Liberty Loan parade. The gun was hauled on a 3½-ton Stegeman truck. The P. & H. Engineering Department designed the gun and the pattern shop handled the wood work. The traffic department contributed the truck and the excavation department contributed the corduroy (caterpillars) and broad-face wheels.

This picture at once suggests the practicability of the P. & H. corduroy traction for heavy guns for service in France. It is believed that the cannon here shown is the first cannon mounted on corduroy traction built in America.

The corduroys used in this machine were a pair of standard corduroy tractions, 20-in. face and 5-ft. 6-in. between the center lines of the end sprocket shafts. This size corduroy is regularly used on the P. & H. 8½-ton pipe line excavator and has a carrying capacity of about 1,000 pounds to the square foot.

Here are the specifications for this corduroy grip traction (as written for the corduroy traction P. & H. ditcher):

"Corduroy Grip" tractions are provided for supporting the rear, or heavy end of the machine. These tractions are each 20 ins. wide and 5 ft. between the center lines of the end sprocket shafts. They are driven by means of chains through a differential on the main propelling shaft. The main frames of the tractions are built up of structural material and are

HEAVY GUN MOUNTED ON CORDUROY GRIP TRACTION.

pivoted on a heavy shaft supported in bearings on the under side of the car body. This enables the tractions to accommodate themselves independently to inequalities in the ground and relieves the main frame work supporting the machinery of all twisting strains. The traction chains are made up of steel casting links with manganese steel bushings and pins, insuring long life to the parts. The supporting blocks are of hard wood fitted on their upper surface into sections of steel channel and shod on their lower or bearing surface with steel plates. The pressure between the supporting blocks and supporting frame is taken by a series of chilled iron rollers of large diameter. The general design of the tractions is such that they can easily be dismantled for repairs.

A New Gasoline Rock Drill

The Scott gasoline rock drill has been developing for a number of years and in its present form is here illustrated.

This machine is a complete self-contained rock drilling plant, mounted on a tripod and eliminating the power plant and pipe lines required by other drills. Although these drills have been operated in the St. Louis quarries for the past five years, the maker did not feel fully satisfied to put his drill on the market until now. A Scott drill operating at the Glencoe Lime and Cement Company, St. Louis, Mo., has drilled 68 ft. in a 9-hour day, using 2 gals. of gasoline and ¼ pint of cylinder oil. The rock was hard limestone.

The size of machine developed will drill holes up to 12 ft. in depth, weighs 200 lbs. without the mounting, and all parts are enclosed and protected. Gasoline is supplied from a small steel pressure tank—a pressure of 2 lbs. is pumped up by hand twice per day—about one minute required for pumping up pressure.

The drill operates on the "hammer" principle. A hollow hexagon drill steel is used (no special shank is required) and the water for cooling the engine is run through the hollow steel to the bottom of the drill hole. About 800 blows per minute are struck. The engine is a simple single cylinder two-cycle and is free from valves, gears and cams. The hammer is moved directly by explosive pressure and strikes a "free piston" blow. There are two pistons, one contained within the other. The outside piston is the hammer and has no mechanical connection with the inside piston, which latter is connected to the crank shaft through connecting rods. An explosion takes place with every down stroke, driving the two pistons downward. The hammer piston strikes its blow on a tappet (which contacts with the end of the drill steel) at about 60 degrees before the crank shaft has reached its lower dead center. The inside piston moves on (independent of the hammer piston) with the crank shaft. The inner piston uncovers

THE SCOTT GASOLINE DRIVEN ROCK DRILL.

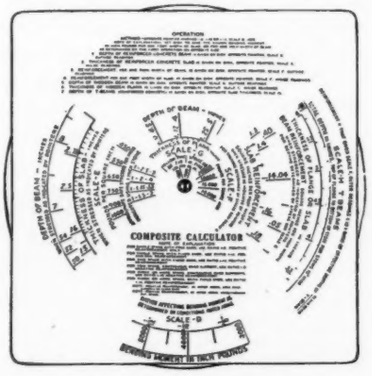
air ports in the hammer piston (on its independent downward movement) and on the back stroke (caused by the momentum of the flywheels) the hammer is picked up on a cushion of air. When the hammer strikes its blow it is free and disconnected from all parts. It will be seen by this arrangement that no shock to the crank shaft or bearings is possible. Ball and roller bearings are used on the crank shaft and rotation shaft. The drill steel is rotated step by step by a special "compound" gear, no ratchets being used to get intermittent rotation.

A Composite Calculator for Engineers

The composite calculator here illustrated is a handy calculator for designing reinforced concrete slabs, beams and girders of every description and for various kinds of wood. For designing the following results can be obtained: Size of reinforced concrete plain beams; size of reinforced concrete tee beams, thickness of reinforced concrete slabs, reinforcement for plain and tee shaped concrete beams; size of various kinds of wooden beams, and thickness of various kinds of wooden planks and boards.

It is equally useful for: Checking the safe load that any beam or slab of known size and span will carry; for comparing the relative size of plain and tee concrete beams with

no change of the disk's setting, thereby giving the proper section of beam both at the center of the span and at the haunches where the relative position of tension and compression are reversed; for taking into effect the action of built-in beams of one span as well as the continuous action of several spans; for directly comparing the relative size of concrete shapes with those of various kinds of wood, and for multiply-



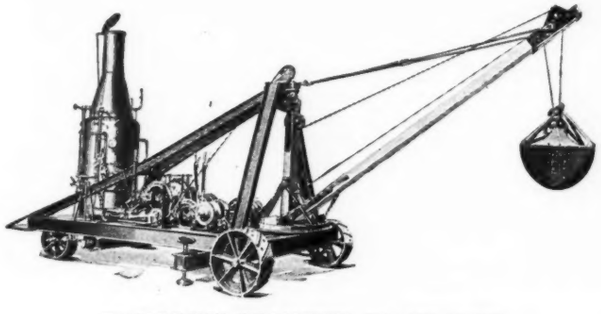
A COMPOSITE CALCULATOR.

ing and dividing as on the ordinary slide rule with the additional advantage that the result is pointed off. All computations for concrete are based upon the joint committee recommendations, using the Straight Line Formula. The composite calculator was recently placed on the market by Kolesch & Co., of New York City.

Traveling Transfer Machine Useful on Construction Work

When equipped with a clamshell the Clyde traveling transfer machine here illustrated will load or unload cars or trucks or handle to and from bins and stockpiles stone and sand. With clamshell removed, the machine becomes a traveling crane or can be used for driving piles. Two men, one engineer and one laborer, operate the machine.

The machine is mounted upon cast semi-steel wheels and is self-propelling at a speed of 2½ miles an hour, enabling it to be moved to any point for loading or unloading; or to avoid blasting work.



TRAVELING TRANSFER PLANT UNIT.

The front wheels are the driving wheels, and rear wheels the steering wheels. The steering is controlled by a hand wheel on the deck next to the boiler. The propelling is accomplished by a chain and sprockets from the engine shaft through an intermediate shaft to the front axle. The engine is 6¼x8 in., double cylinder, double drum, 20-h.p., mounted on the car frame. It has a load capacity of 4,500 lbs. on a small line.

On the front end of the car is mounted a rectangular frame of structural steel efficiently braced to support the mast top. The mast top is of 8x8 in. timber; the bull-wheel is 4 ft. in diameter. The boom is 20 ft. long, fitted with clamshell boom end. The complete machine is given stability by outriggers extending from the top of rectangular frame and ending in a suitable bearing shoe.

Special Road Roller with Scarifier Attachment.

A special road roller with a scarifier attachment is here shown tearing up a bituminous macadam. This Buffalo Pitts roller will also tear up concrete pavements and bases. They have great flexibility of operation as they can also be used for light surface loosening and for the removal of sheet asphalt and sand oil carpets for the application of new coats. Contractors have had good satisfaction from their use of this machine. Henry P. Burgard Co., General Contractors, Buffalo, N. Y., tried one of these machines in the fall of 1915 in tearing up sheet asphalt, tearing up concrete base under old sheet

STANDARD ROAD ROLLER WITH SCARIFIER ATTACHMENT.

asphalt pavement and in tearing up macadam. They speak highly of the service rendered by the machine. The German Rock Asphalt & Cement Co., of Buffalo, report that this machine does work in a day in ripping up concrete base that would cost $150 by other methods.

The loosening device is reversible as well as the roller. The teeth are adjustable for depth and angle of penetration. Hand wheels govern the depth of penetration. For light work full sets of short teeth are usually employed, while for heavy excavating a lesser number of longer teeth are used. The latter are self-sharpening. The scarifier attachment does not in any way impair the usefulness of this standard roller.

Plant Units Used on Construction of Camp Devens, Ayer, Mass.

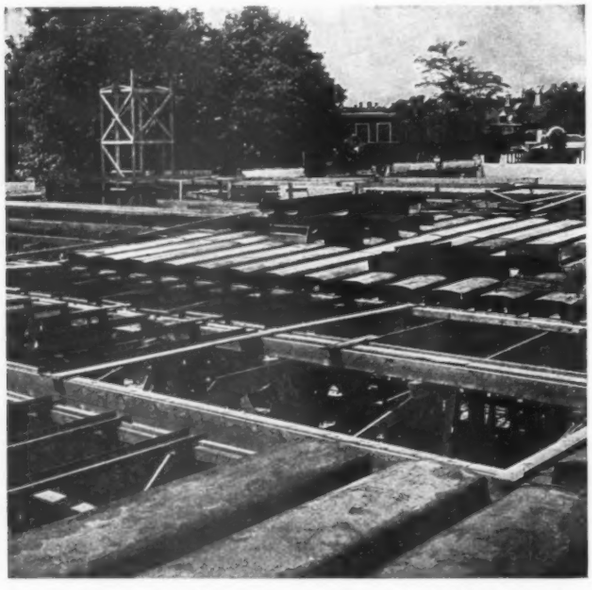
On the construction of the National army cantonment at Camp Devens, Ayer, Mass., the following plant units were used by Fred T. Ley & Co., Inc., Springfield, Mass., the general contractors: 19 concrete mixers, including ½ bag Ran-

some Bantams and 1 bag Standard mixers; 5 trenching machines, of which two were Pawling & Harnischfeger, 2 Buckeye and 1 Parsons, respectively; 1 P. & H. backfiller; about 100 motor trucks, ranging from 750 lbs. to 5 tons capacity, and including 6 Duplex 4-wheel drive, 4 Smith Forma-Trucks, Mack, Saurer, Pierce-Arrow, Peerless, etc.; 3 steam shovels, consisting of a ⅝-yd. Manon, ¾ yd. Osgood and a ⅞-yd. Bucyrus; 2 10-ton Buffalo road rollers, about 50 dump wagons of all makes, 1 7x10 D. D. Lidgerwood hoisting engine, 1 78-ft. mast, 76-ft. boom Terry & Tench derrick, 1 1-cu. yd. Haiss clamshell bucket, 20 portable saws, including 6 S. A. Woods Co. railway cut-off, and 4 automatic feed of Woods manufacture, 2 Elliot saw rigs, 6 American portables with Novo engines and 2 A. E. Kidder No. 2; 2 Studebaker sprinklers, 10 Novo trench pumps and 2 Keystone excavators. Each piece of plant sent to the job was appraised and the government reserved the privilege to buy it from the contractors.

The Uni-Form System of Floor and Roof Construction

The Uni-Form system of floor and roof construction in reinforced concrete has for its distinguishing feature a system of removable steel forms composed of channels combined with arch plates or pans, and coupled by spreaders. When poured and stripped there is left a monolith floor consisting of joists and arched connecting slabs. The system requires support only on 10 ft. centers, instead of thick shoeing necessary in the ordinary beam and girder or flat slab construction. The steel forms are stiff, strong and permanent in shape and are stripped from the concrete on each job to be used over again indefinitely. They are a part of the concrete contractor's plant.

The system consists primarily of steel channels, concave side up, into which are clamped a series of inverted pans stuck up in dies from 14-gage steel. Through punched holes

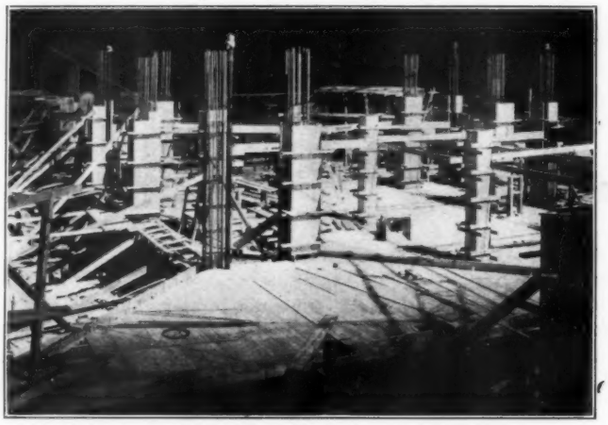


GENERAL ARRANGEMENT OF THE UNI-FORM SYSTEM

in the channel web ⅝-in. stock machine bolts are slipped and these engage similar holes in the spreader. The spreader forces the pan hard against the channel flange, thus binding the whole system rigidly together and preventing leakage of cement. The forms are so rigid that loaded concrete cars or wheelbarrows can be run over them without danger or distortion. The wood shoeing used in the Uni-Form system is also salvaged until worn out by repeated usage. This system makes possible the saving of 40 per cent. of the concrete in flat slab construction of the same strength. Carpenter work is required on the girder forms; aside from that the system is practically erected by common labor.

Flood Lamps Facilitate Night Construction Operations

The accompanying view shows the Edgewater Beach Hotel, Chicago, under night construction. This night work was made economically feasible by the use of Western Electric Davis Flood Lamps. Two of the units were mounted on top of the concrete hoisting tower, 185 ft. above the ground, and turned on the work below. They gave practically daylight efficiency. The light from these lamps is diffused rather than in beams



LIGHTING NIGHT CONSTRUCTION FROM TOP OF CONCRETE HOISTING TOWER.

centering on particular spots. For outside work they are usually mounted on tops of buildings or poles, where they give best distribution over a maximum area. For interior use they are mounted close to the ceiling. A steady lighting effect is secured. The lamps operate either on direct or alternating current. In addition to their use on construction these lamps are used for lighting factory yards, railroad yards, etc. They use a 750 or 1,000 watt standard Sunbeam Mazda lamp.

Snow Removal Methods and Equipment

Where can I obtain the latest information regarding snow removal methods and equipment? This is a community of some 1,500 people and it has concrete roads and sidewalks. We have been using horse-drawn snow plows to open up channeds of traffic, but it occurred to me that some more practical and inexpensive method may have been developed. Can you refer me to any articles in recent publications along this line?

D., Manager, ———, Minn.

The latest on this subject will be found in MUNICIPAL ENGINEERING. The street cleaning departments have found by experience, much of the development having been made within the past three years, that the easiest and most economical way of opening up lines of travel is to begin promptly when the snow begins to fall and keep up the work until the streets and sidewalks are all clear. By following this plan the exertion required is not so great and melting or packing of snow under traffic does not render removal difficult or impossible. Plows, scrapers and brooms are the principal weapons used, horse or auto-driven according to taste or facilities. In MUNICIPAL ENGINEERING for February, 1916, are two articles, one on "Systematic Snow Removal in New York" and one on an "Auto Truck Snow Plow," and in June, 1916, one on "Prompt Snow Removal in Philadelphia, and in November, 1916, one on "Removal of Snow in Parks, Problems and Methods," all illustrated, which give the latest experience and advice of the foremost experts on this subject.

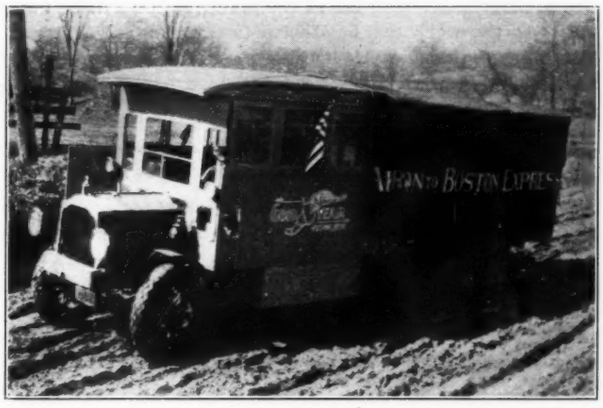
DIGEST OF THE ESSENTIAL NEWS

Highway Motor Truck Freight Trains Now Running Between Akron, Ohio, and Boston, Mass.

Highway freight trains are now running in the United States—running over country roads, from Akron, Ohio, to Boston, Mass., and return; covering a distance of 1,510 miles in a week.

Thus, what all the good roads propaganda for the past 15 years has failed to achieve, the freight car shortage and a national crisis have accomplished. The public has been forced to make greater use of its greatest transportation asset—the country road.

The truck line from Akron to Boston is being operated by the Goodyear Tire and Rubber Company. It is called the "Akron & Boston Express." The present equipment consists of two Packard and two other trucks, of 1½, 3 and 5-ton capacity. It is planned to increase the equipment, and, according to J. L. Sydnor, the company's efficiency specialist, additional trucks are already ordered.



VIEW OF ONE OF THE MOTOR TRUCK FREIGHTING UNITS OPERATING BETWEEN AKRON, O., AND BOSTON, MASS.

A regular schedule is maintained. M. D. Scott, manager of garage, says they are usually on time. The schedule calls for the round trip (1,510 miles) in less than one week. Mr. Sydnor says that the express companies do not deliver stuff as rapidly as that, and that the truck costs are competing with express rates. Tires are loaded for their Eastern branches and cotton fabrics and machinery for their plant in Akron is carried on the return trip. Several trips have been made to Washington, D. C., with "war orders" and good time was made.

Messrs. F. A. Seiberling, president, and P. W. Litchfield, factory manager, are the instigators of the movement. Service was started last April and Mr. Sydnor hopes to continue through the winter unless stopped by too much ice and snow. There is only 28 miles of unimproved road, which bothers considerably in muddy weather. The poor condition of some of the old wooden and steel bridges is another handicap. Pneumatic tires are used exclusively, at a greater cost per tire mile, says Mr. Sydnor, but with less wear and tear on trucks and roads.

The country road is at last coming into view as "the railroad of tomorrow."

Detroit Has $8,250,000 Available for Sewer Construction

Within the last two years the city limits have been extended in such a manner as to about double the area of the City of Detroit. Portions of this area are already built up and are without proper sewerage facilities.

On July 1 a bond issue of about $8,250,000 became available for the construction of approximately 31 miles of trunk sewers, the intention being to provide for a 2-year program. Bids were recently received for two sections of sewer ranging in size from 5 ft. to 14 ft. in diameter, covering a length of approximately 5 miles. However, due to war conditions bids received were so far in excess of the money available that no contracts have as yet been let, writes Clarence W. Hubbell, city engineer. It is expected to re-advertise a portion of this work and one or two other sections in the near future, in the hope that better prices can be obtained.

The trunk lines outlined form a portion of a system which will eventually include three treatment works, as treatment works will be necessary in order to comply with the treaty requirements between the United States and Great Britain in regard to the pollution of boundary waters. Treatment works, however, have not yet been authorized by the city, except for the purchase of one of the sites.

In addition to the trunk lines, petitions are filed for perhaps 100 miles of lateral sewers, in addition to the 50 miles which we hope to complete before the close of the season. Contracts for lateral sewers are being let approximately every two weeks, 10 to 12 jobs being advertised each time. Lateral sewers are paid for by lateral sewer bonds or the proceeds therefrom, and the cost of the lateral sewer is assessed against the abutting property.

New York City Merchants Will Co-operate with Street Cleaning Department in Snow Removal

Street Cleaning Commissioner Featherston has informed the committee of the Merchants' Association of the City of New York that the difficulties hitherto encountered by his department in obtaining sufficient labor for prompt removal of snow will be greatly increased during the coming season by the scarcity of the labor supply. He is of the opinion, therefore, that unless effective plans for cooperation by merchants, truckmen and railroads to give aid in snow removal can be arranged, extremely serious and protracted interruption of street traffic may occur during the coming winter.

Details of the Plan.

The committee, in conference with the Street Cleaning Commissioner and the Motor Truck Club of America, has considered a plan for the purpose named. It is proposed that immediately following a heavy snowfall, merchants agree to suspend a certain designated class of outward bound shipments during say, one-half of the day for a period, if necessary, of two or three days; that during such time of suspension they release their trucking contractors from the obligation of moving freight and thereby permit such trucking contractors to place their trucks at the disposal of the Street Cleaning Department; that merchants and shippers whose packers and porters cannot be fully employed while the movement of

freight is suspended assign such packers and shippers as can be spared to the duty of loading snow from the streets in the immediate vicinity of such merchant's premises upon the trucks so released.

Under this plan several hundred trucks or more, together with the necessary help for loading, can be at once employed in the removal of snow from business streets designated by the Commissioner, whereas several days would necessarily elapse before all of the streets in question could be freed from snow if only the force of the department were employed.

Cook County (Ill.) Votes $1,000,000 Road Bonds

The $1,000,000 county road bond issue carried at the judicial election held on Nov. 6 in Chicago and Cook County.

The need of a bond issue was suggested primarily by the much discussed plan for a military road from Chicago past Ft. Sheridan and the Great Lakes Naval Training Station to the Wisconsin state line. A little more than half the cost of paving this highway was offered by the state and federal governments on condition that Lake and Cook Counties do the rest. Lake County has also voted its share of road bonds to defray the cost of this highway work.

Roads to Be Improved.

In addition to this route these highways have been surveyed and provided with permanent pravements:

One Hundred and Forty-seventh street, from Forty-eighth avenue to the Village of Orland, thence to Tinley Park.

A road through Homewood, Thornton and Lansing, to connect with the Lake County, Indiana, system of main highways.

Three miles of Lake street to the county line, and the extension of Irving Park boulevard to the county line.

Other Improvements Planned.

Other roads which the county authorities want to pave, and which were included in the bond issue plan, are the unimproved portions of Archer avenue, on the projected Chicago, Springfield and St. Louis highway; the Desplaines River road, through the recently acquired forest preserves, from Twelfth street to Milwaukee avenue; the Lincoln highway, from Chicago Heights east to the state line and west from the present construction to the county line, and about 10 miles of road through Glenwood, Thornton and Riverdale, to provide an additional southern entrance to the city.

Altogether, something like 80 miles of new pavements is contemplated—all on main traveled routes.

Present Status of Road Work in Massachusetts

As has been the case in all public works during 1917, the high cost of labor and material, together with the difficulties of securing material by rail on account of embargoes and scarcity of railroad equipment, has caused much greater expense in construction and maintenance work and also much delay in carrying on work, with the consequent inconvenience to the traveling public. We have, however, succeeded in completing a large number of contracts and in keeping our state highways in good condition for travel, writes Arthur W. Dean, Chief Engineer, Massachusetts Highway Commission.

During the latter part of the year we have confronted not only high prices in labor, but a great scarcity of labor owing to the drain made upon the labor market by the construction of the cantonment in this state.

As in previous years, we have built several different types of road surfaces, being governed by the amount of traffic to be carrried and the availability of building material. The prevailing surfaces which we have constructed, however, have been bituminous macadam, bituminous concrete and cement concrete.

The present outlook for 1918 is not encouraging, but should conditions be no worse than they have been during the present year, it is probable that we shall continue constructing about the same amount as during 1917, and shall, of course, carry on maintenance and necessary reconstruction of state highways.

Should conditions grow worse, it may be necessary to limit activities to maintenance alone.

The state expenditures during the year 1917 will amount to approximately $4,000,000, and it is anticipated that approximately the same amount will be available for use in 1918.

Kansas All Set for Brick and Concrete Road Construction

Practically all of the Kansas road and bridge laws were revised and modified by the legislature last winter and the townships and counties have been busily getting organized under the new law, writes W. S. Gearhart, state highway engineer.

Practically all of the county engineers have now been appointed and approved by the Commission. Most of the counties have selected their county road systems and these systems will be approved by the state highway engineer very soon.

Kansas appropriates no money for road building on account of the constitutional provision and all of the funds for road and bridge construction are provided from the local communities. Most of the surfaced road work will be financed by the Benefit District plan and a great deal of the road work which is being petitioned for at the present time will be under contract so the work can be started next spring. Not a great deal of surfaced road work has been done this year. Most of the work now being petitioned for will be brick or concrete.

Road Work in Albama in 1917 andPlans for 1918.

By W. S. Keller, State Highway Engineer, Montgomery, Ala.

The Alabama Highway Commission is working under a law passed by the Legislature in 1911. At that time demonstration work was badly needed in nearly every county in the state. The law was so framed as to give every county, regardless of area, population, or road mileage, an equal amount of money annually. The amount appropriated was $2,000 annually to each county, which would be available for a period of two years. Any county failing to take the appropriation within the two years period would lose it and it would be redistributed among the 67 counties of the state. Illustrating this, the appropriation to the counties for the current year is $2,439.52, of which $439.52 is 1-67th part of unused funds for the year 1915.

Demonstration work has long since ceased to be necessary and the law, consequently, is to some extent out of date. The Legislature of 1915 passed what is known as the "State Trunk Road Law." This law designates certain roads in the state as State Trunk roads and makes it unlawful to use state funds on other than such roads unless all state trunk roads in a county have been constructed to the satisfaction of the State Highway Commission. In such cases the money may be used on any other main traveled highway.

The Trunk Road System.

The trunk road system embraces approximately 3,000 miles, of which about 1,500 is now in good condition. Less state aid construction work has been done during the present year than than for a like period for several years. The main reason is the counties anticipating the federal appropriation have preferred to allow the state funds due them to accumulate in order that they might use such with their own funds to secure such allotment of this federal fund as the State Highway Commission might give them.

There not being sufficient state appropriation to meet the

federal appropriation, it is necessary for the State Highway Commission to ask the counties to meet the allotment with their own funds, to a very great extent.

We have spent during the present year on roads finished and still under construction, including county funds used with state funds, a little over $100,000. The roads constructed have been mostly gravel and sand clay. A few miles of chert and macadam roads have been finished, and a few counties have used their state aid in building concrete bridges.

Approved Projects.

Alabama's allotment of federal aid of the fiscal year, 1917-1918, is $312,446.70. The State Highway Commission has submitted statements for 29 projects, of which 18 so far have been approved. A summary of those approved, showing estimated cost and milage, is as follows:

84.81	miles sand clay road	$221,350.42
36.65	miles gravel road	122,119.37
5.5	miles chert road	22,834.35
2.5	miles bituminous macadam road	21,564.10

Most of this work will be under way by January 1. Priority Order No. 2, issued by Judge Lovett, will delay the construction of about half of the gravel work and the macadam.

In addition to this work a number of counties will take state aid alone for the construction of small sections of their trunk roads yet in bad condition. Including the federal appropriation for the fiscal year 1919, available July 1, 1918, and a like sum to meet it, with the present appropriations, over $1,000,000 worth of work should be finished and under way by the close of 1918.

Engineer Proposes Concrete Mains to Carry Natural Gas

Concrete will aid materially in relieving the pipe shortage and bring natural gas to New Orleans at an early date, in the opinion of Howard Egleston, a New Orleans civil engineer. Under present conditions, Mr. Egleston believes it is not only a wise but a patriotic duty to make a thorough test of the use of concrete gas mains, and he quotes others to sustain his views.

The test of concrete gas mains, Mr. Egleston says, can be made at no great cost and with the loss of but little time. If the test is successful, and he has no doubt that it will be, a concrete gas main can be constructed from the Terrebonne field to New Orleans within a year.

Mr. Egleston's plan is to construct two large concrete gas mains from the Terrebonne district to the city. Two large mains, he says, will not only furnish an abundant supply of gas, but will safeguard the city against accident. If one of the mains should be out of order the other would furnish a supply of gas until the damage could be repaired.

Scheme in Operation.

Calculation shows, says Mr. Egleston, that with a pipe 36 in. in diameter and 10 miles long, 50,000,000 cu. ft. of gas can be delivered, using a pressure of only 10 pounds. I therefore, propose to drive the gas through the first 10 miles of the pipe line by means of the "rock" or natural pressure, then "boost" it along another 10 miles by using a turbine blower or compressor, and so repeat through the length of the pipe line till the city is reached. To deliver 100,000,000 cu. ft, of gas per day it will be necesary to lay two lines of pipe, which will be highly desirable, for accident to pipe or machinery of one line would not cut off the city's supply.

Making concrete pipe that will stand an internal pressure of 10 lbs. is a matter of daily manufacturing practice. Any well made machine-made pipe will stand a much higher pressure, and can be, and often is, made so that it will safely stand pressures of 40 lbs. and more. In our case it would probably be a matter of extra safety and wisdom to use some slight reinforcement.

Preventing Leaks.

The matter of making pipe gas tight was more serious, for a pipe that will stand a heavier internal pressure of water may leak gas at a very low pressure, but after corresponding with a number of the largest and oldest manufacturers of waterproofing materials, some of whose names were supplied me by the director of the United States Bureau of Mines, I have the assurance from many of them that they will guarantee that the pipe can be made absolutely air and gas tight. Which process will prove to be the best remains to be demonstrated by tests.

Using Dynamite in Excavating Creek Gravel

By J. U. Bradley

There is a plentiful supply of excellent gravel for making concrete and for road surfacing purposes in a creek bottom near Hazelwood, Indiana. The creek is about 100 ft. wide, and the best gravel is obtained from the creek bed where the flowing water has washed out the foreign material and sediment, leaving the gravel clean and free from dirt.

Since the excavation must all be done under water, a good heavy drag chain with buckets attached is dragged across the bottom, bringing the gravel up and dumping it. It was found that at a depth of about 6 ft. there was a layer of hardpan in which the buckets would jam, and stop operations for some time until they could be loosened. This hardpan was about 18 ins. thick, and was underlain by good gravel, but as the buckets would not penetrate it, only the gravel above the hardpan was used.

Though not in charge of the work, I suggested that I be allowed to try the effects of dynamite for loosening the chain and buckets after they had become jammed in the hardpan about 6 ft. under water. Accordingly, I obtained some Red Cross Dynamite and made up several one-cartridge primers with a cap, and about a foot of fuse for each cartridge. These were lighted and dropped into the water at 10-ft. intervals along the chain, while at the two ends, where the hardpan seemed to be the strongest, two cartridges tied together were used.

The machinery was they started up, and the chain was found to be free, the buckets coming up full. The blasting had not only loosened the chain and buckets, but had broken up the hardpan and loosened the gravel, so that every bucket worked to capacity. During a timed four-hour run immediately after the blasting, 40 cu. yds. mors of gravel were excavated than had ever been done in a samilar period before. This showed conclusively that the job could be handled more economically by using explosives, and that the underlying gravel status could be rendered available for use.

Road Work in New Hampshire

Plans for highway work in New Hampshire for 1918 have not as yet been made. "While we have had an appropriation for two years, 1917-1918, for new construction larger than for the two previous years," writes Frederic E. Everett, Commissioner of the New Hampshire Highway Department, "we have been able to accomplish but very little work owing to the scarcity of labor and the impossibility of getting road material.

"Up to the time most of our trap rock for road work has been shipped in from Massachusetts. Owing to embargoes we have been unable to get shipments this year and therefore we have not accomplished anywhere near the amount of work we had laid out. State aid construction is going on, but this work started at least six weeks later than usual and none of it will be completed.

ADVANCE INFORMATION ON BIG JOBS

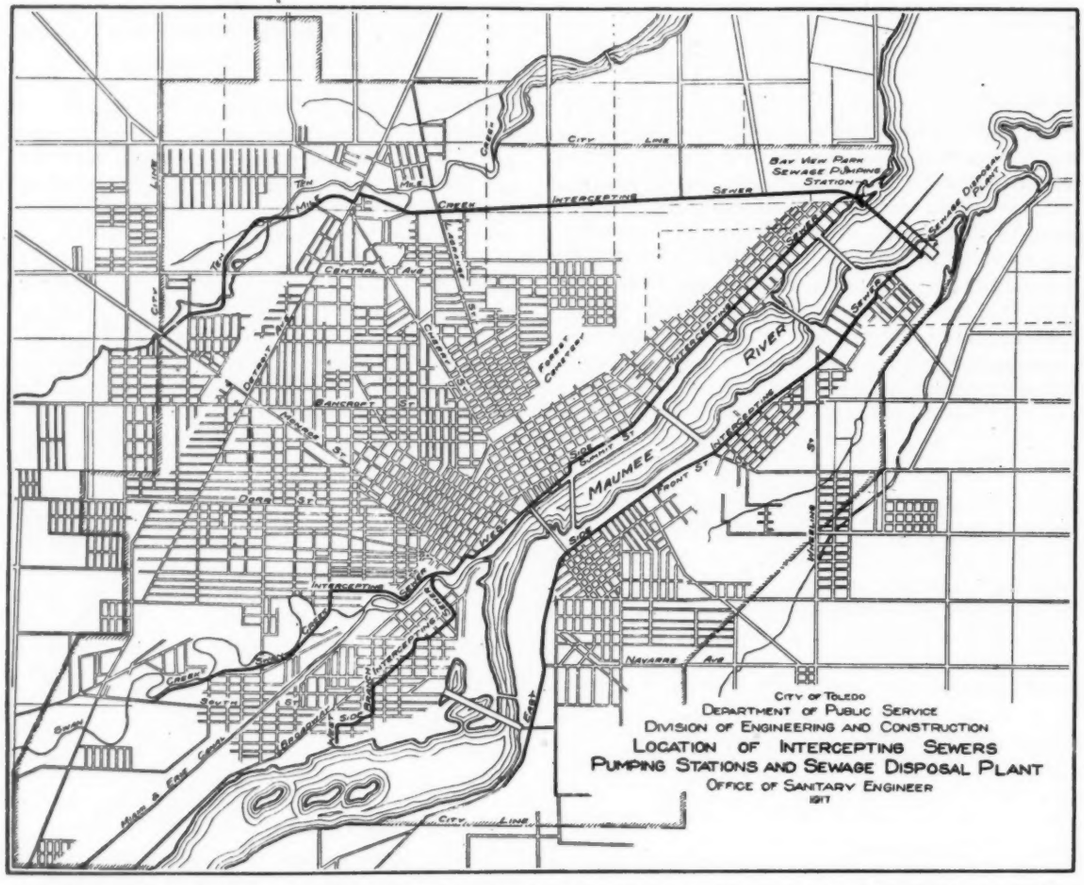
Toledo Votes $2,800,000 for Sewage Collection and Disposal

The sewage collection and disposal bond issue carried by a large majority at the election held on Nov. 6, 1917, in the City of Toledo. H. C. McClure, commissioner of engineering and construction, writes that his department will be in a position to push the work according to the prearranged program.

The bond issue of $2,800,000 was approved and portions of this authorized issue will be voted from time to time by the council to take care of the necessary parts of the complete plan. The entire plan calls for some 20 miles of sewers, ranging in size from 48 in. up to perhaps 84 in., numerous interceptors with combined sewers, several siphons, two pumping plants and a complete disposal plant.

It is planned to ask council to authorize $700,000 of this total issue at once in order to take care of what is known as the Ten Mile Creek Interceptor and Bay View Park Pumping Plant. This interceptor will be approximately 6 miles in length, 48 in. to 72 in. in size, several interceptors and two siphons. About half of the length will be in open-cut and the balance will be entirely in tunnel.

The pumping plant building will be of such size that ultimately it will have a capacity of at least fifty million gallons per day. The building will be built in a park district and will be a handsome, substantial structure. Motor-driven centrifugal pumps will be installed to take care of about fifteen million gallons at this time.



MAP SHOWING ESSENTIAL FEATURES OF PROPOSED SEWAGE COLLECTION AND DISPOSAL SYSTEM, TOLEDO, O.

PROPOSED BAY VIEW PARK PUMPING PLANT, TOLEDO SEWERAGE SYSTEM.

The bond legislation will take at least 60 days so that this Ten Mile Creek Interceptor and Bay View Park Pumping Plant will not come up for actual figures until about February 1st. "At that time we would be very glad to get in touch with responsible contractors who are capable of handling jobs of this magnitude," says Mr. McClure.

Engineers Recommend $3,000,000 Sewage Treatment Plant for Indianapolis

A report on the sewage disposal situation in Indianapolis was recently submitted to the Board of Sanitary Commissioners by George W. Fuller, of Fuller & McClintock, Consulting Engineers, 170 Broadway, New York.

Projects Considered.

Detailed study was given to three projects for the treatment of the sewage in plants of a size sufficient to deal with the flow of 1925, as follows:

Project 1. Sedimentation in Imhoff tanks with the sludge put on drying beds so as to allow it to be used by farmers in the vicinity, or for filling low land, and with settled sewage oxidized to a non-putrescible state in sprinkling filters and settled in humus tanks, frequently spoken of as final settling tanks.

Project 2. Aeration of the sewage in contact with activated sludge, followed by sedimentation and with the deposited sludge filter-pressed and dried in rotary dryers in order to put it into condition for sale to the fertilizer trade.

Project 3. Fine screens to remove the coarser suspended solids, with the screened sewage applied to deep sprinkling filters for purposes of oxidation, and with the effluent thereof put through humus tanks, the sludge from which will be filter-pressed and dried for sale to the fertilizer trade.

The Project Recommended.

After due consideration of all local factors, we recommend, reads the report, without qualification, the adoption at the Sellers Farm site of Project 3, consisting of fine screens, deep sprinkling filters, humus tanks and sludge-drying arrangements to allow the sludge to be sold to the fertilizer trade. This project represents an investment estimated at $3,090,050, with net operating expenses reduced by the sale of sludge to $42,372.

We understand that this investment cost is in excess of available funds, and in view of these circumstances we formally recommend that the intercepting sewer, grit chambers, pumping station and fine screen plant be installed of full capacity, and that the filters, tanks and sludge-treatment arrangements be built of about two-thirds of the capacity for 1925 conditions. This would make an investment cost of $2,438,000, with net operating expenses of $50,370, the return from sales of sludge being necessarily less than for the unmodified project.

Modifications Suggested.

This modified project, called 3-A, would provide for the elimination of the gross sewage solids continuously throughout the year and for short periods of exceedingly warm weather and low stream flow would treat enough sewage to prevent objectionable putrefactive conditions in the lower White River. Certainly the corrective treatment will afford a substantial remedy, and as additional funds become available, additional units may be installed to meet the needs of the increased sewage flow up to conditions of 1925 and thereafter.

Projects 1 and 2 might also be built at first with only a part of the units needed for 1925 conditions, with additional units added as construction funds become available. But if treating only two-thirds of the dry-weather flow of 1925, Projects 1A and 2A become impracticable on account of their annual net operating expenses becoming $73,690 and $64,950 respectively, as compared with $50,370 for Project 3A. The latter sum is negotiable under the existing Act, but neither of the other two sums is.

Taking everything into account, we are firmly of the opinion that Project 3, modified in capacity to such extent as financial necessity demands, is the wisest and best method to adopt for treating the sewage of the Indianapolis Sanitary District.

Statement by Sanitary Commissioners.

The Commission made the following statement concerning the report:

"The Board of Sanitary Commissioners will take further time to study the report of Mr. Fuller. Consideration will be given to Projects 1 and 3, the board agreeing with Mr. Fuller that Project 2 is not applicable to local conditions. The board wishes to investigate more fully the feasibility of pressing and drying the sludge for fertilizer on a large scale and the market for such commercial fertilizers, the expense of operating a sludge pressing and drying plant, and the reliability of mechanically operated screens.

"The estimates of the three projects, as made by Mr. Fuller, were based on the prevailing high prices, and with a tendency toward reduction in prices of building materials, which has occurred within the last few days, especially cast iron and steel, the board feels that it will be able to construct an entire plant under Project 1 or 2 within the amount of money which will be available for constructing a sewage disposal plant.

"Indianapolis is fortunate in that a large gravel bed underlies the site for the sewage disposal plant in Sellers' farm, and that since the structures required for a sewage disposal plant are composed almost entirely of concrete a great part of the material required is already at the site.

Plans Now Well Under Way.

"Although the commission has not decided on the final method of treatment for sewage best adapted to local conditions, plans for the necessary interceptor and the pumping station which will be required in all three projects are now well under way.

"The board has had an appraisal made of the present garbage disposal plant and estimates of the changes required to better the sanitary conditions. Before the end of the year steps will be taken to acquire this plant or to construct a new garbage reduction plant in conjunction with the sewage disposal plant."

The Board of Sanitary Commissioners consists of B. J. T. Jeup, City Engineer, president; Charles H. Hurd, Consulting Engineer, Indianapolis, vice-president, and Jay A. Craven, secretary. The Commission plans to go ahead with the work and has retained two engineers on their staff, W. H. Durbin, of Evansville, Ind., and A. G. Husted, Cleveland, O. Mr. Fuller was assisted in preparing the report by Paul H. Norcross, Atlanta, Ga.; by James R. McClintock and Jesse K. Giesey, of Fuller & McClintock.

COMING CONVENTIONS

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS—Annual meeting at Hotel Jefferson, Richmond, Va., Dec. 4-6. Acting Sec'y, H. M. Berry, Chapel Hill, N. C.

NEW JERSEY STATE LEAGUE OF MUNICIPALITIES—Annual convention at Trenton, Jan. 3-4. Sec'y, Clinton A. Swartz, Trenton.

VIRGINIA GOOD ROADS ASSOCIATION—Annual convention at Richmond, Jan. 15-17, 1918. Sec'y, C. B. Scott, Richmond.

AMERICAN CONCRETE INSTITUTE—Annual meeting at Chicago, Feb. 7-9. Sec'y, Harold D. Hynds, 27 School St., Boston, Mass.

CONTRACTORS AND BUILDERS SHOW—Supersedes annual Chicago Cement Show. To be held under auspices of the National Exhibition Co., 123 West Madison St., at the Coliseum, Feb. 6-13, 1918.

IOWA ENGINEERING SOCIETY—Annual meeting at Waterloo, Feb. 20-21. Sec'y, J. H. Dunlap, Iowa City, Ia.

HOW THE CONTRACTORS ARE BIDDING

Bids on Road Construction in Pennsylvania

Herewith are given the bids received October 9, by the Pennsylvania State Highway Department for the construction of certain sections of road. The schedule of bids was furnished by J. D. O'Neil, State Highway Commissioner.

Cambria County, East Taylor Township, Route 52, Section 4-C, 9,878 linear feet of vitrified block pavement, 16 ft. wide.

E. H. Brua, Hollidaysburg, Pa.	$ 78,855.43
Mainwaring and Cummins, Inc., Germantown, Philadelphia, Pa.	92,934.30
G. T. Morgan, Johnstown, Pa.	83,900.75
Richard Hopkins, Troy, N. Y.	80,751.60
John L. Elder, Ebensburg, Pa.	79,624.46

Cambria County, Jackson and East Taylor Townships, Route No. 52, Section 4-B, 11,070 lin. ft. of vitrified block pavement, 16 ft. wide.

Mainwaring and Cummins, Inc., Philadelphia, Pa.	$109,889.60
John L. Elder, Ebensburg, Pa.	95,881.60
E. H. Brua, Hollidaysburg, Pa.	96,520.19

Lackawanna County, Moosic and Old Forge Boroughs, State-aid Applications Nos. 487-442,—6,562 lin. ft. reinforced concrete pavement, 16 ft. wide.

O'Brien Brothers, Avoca, Pa.	$ 32,308.73
H. B. Sproul Construction Co., Inc., Peekskill, N. Y.	35.138.80
Hagen Lumber Company, Scranton, Pa.	44,132.40
P. J. Boyle Construction Co., Wilkes-Barre, Pa.	32,995.17
Gibbons & Buckley, Philadelphia, Pa.	25,498.96
Matthias Stipp & Son, Scranton, Pa.	27,641.65
Herrick Construction Co., Wilkes-Barre, Pa.	33,792.00
John J. Phillips, LaPlume, Pa.	58,558.50

Washington County, Cecil and North Strabane Townships, Route 108, Sec. 1. 19,318 lin. ft. of vitrified block and reinforced concrete pavement, 16 ft. wide.

Peter F. Connolly, Elmira, N. Y.	$165,139.80

Allegheny County, South Fayette Township, Route No. 108, Section 1, 16,852 lin. ft. of vitrified block pavement and reinforced concrete pavement, 16 ft. wide.

Robert Swan, Jr., Company, Pittsburg, Pa.	$210,720.96

Washington County, East Bethlehem Township, Route 268, State-aid Application No. 738; 5,900 lin. ft. vitrified block and reinforced concrete pavement, 16 ft. wide.

Crosson Construction Company, Brownsville, Pa.	$ 75,322.00

Lehigh County, Hanover Township, Route 159, Section 1; 11,857 lin. ft. of reinforced concrete pavement, 16 to 20½ ft. wide.

J. C. Bentley, Elizabeth, N. J.	$ 72,857.80
George H. Hardner, Allentown, Pa.	69,375.80
Richard Hopkins, Troy, N. Y.	76,838.00
Mainwaring & Cummins, Inc., Philadelphia, Pa.	78,216.35

Butler County, Clinton Township, State-aid Application No. 417; 5,800 lin. ft. of vitrified block pavement, 16 ft. wide.

Robert J. Swan Jr. Company, Pitsburg, Pa.	$ 64,105.50
Norman J. Boyer, Butler, Pa.	30,255.97
Kennedy Contracting Company, Utica, N. Y.	34,729.96

Westmoreland County, East Huntingdon Township, State-aid Application No. 324; 2,540 lin. ft. of vitrified block pavement, 16 ft. wide.

Rimonti Galiardi, Connellsvile, Pa.	$ 20,955.80

Montgomery County, Upper Moreland, Abington and Upper Dublin Townships, State-aid Application No. 648; 6,537 lin. ft. of reinforced concrete pavement, 16 ft. wide.

Mainwaring and Cummins, Inc., Philadelphia, Pa.	$ 50,651.65
Ambler, Davis Company, Philadelphia, Pa.	44,349.60
The Juanita Company, Philadelphia, Pa.	45,511.05

Venango County, Cornplanter Township, Application No. 681; 7,857 lin. ft. of vitrified pavement, 16 ft. wide.

Elmer M. Love & Son, Corry, Pa.	$ 56,663.45

Bids Received on Paving Liberty St., Newburgh, N. Y.

The following alternate bids, reported by Henry Wilson, City Manager of Newburgh, N. Y., were received early in November for the improvement of Liberty St. between Broadway and Renwick St:

Warren Bros. Company.

Bitulithic	$ 30,150.00

Joseph A. Fogarty.

Bitulithic	$ 31,367.25
2-in. Asphalt Block	31,771.00
2½-in. Asphalt Block	32,901.50
Mack Brick	34,193.50

If gravel is used in place of broken stone in concrete foundation, Mr. Fogarty's bids would each be reduced $161.50.

Harper & Higginson, Inc.

Bitulithic	$ 32,870.75
2-in. Asphalt Block	34,889.50
Metropolitan Brick	37,150.50

Henry F. English.

2-in. Asphalt Block	$ 35,384.50
2½-in. Ashphalt Block	36,595.75
Mack Brick	38,210.75

Bids on Highway Work in California.

Table I gives a summary of the proposals opened Nov. 5, 1917, by the California Highway Commission for constructing

Table I—Bids for Constructing a California State Highway, Received Nov. 5.

Items.	Quantities.	Engineer's Estimate.	Geo. R. Curtis, Lso Angeles. Bid.	Geo. R. Curtis, Lso Angeles. Amount.	Fred Hoffman,, Long Beach. Bid.	Fred Hoffman,, Long Beach. Amount.	A. L. McCoy, Los Angeles. Bid.	A. L. McCoy, Los Angeles. Amount.
1. Excavation— without classification	53,700 cu. yds.	$ .40 $21,480.00	$ .90	$ 48,330.00	$ 1.00	$ 53,700.00	$ .75	$ 40,275.00
2. 18-in. cor. metal pipe	858 lin. ft.	.50 429.00	1.00	858.00	1.00	858.00	2.00	1,716.00
3. 24-in. cor. metal pipe	365 lin. ft.	.75 273.75	1.50	547.50	1.50	547.00	2.00	730.00
4. Portland cement concrete— Class "A" (Cul's. & Mon's.)	310 cu. yds.	14.25 4,417.50	15.00	4,650.00	15.00	4,650.00	16.00	4,960.00
5. Portland cement concrete— Class "A" (pavement)	9,800 cu. yds.	5.25 51,450.00	8.60	84,280.00	5.50	53,900.00	6.00	58,800.00
6. Guard rail	4,600 lin. ft.	.45 2,070.00	.50	2,300.00	.75	3,450.00	1.00	4,600.00
7. Monuments (haul and set)	170 each	.50 85.00	1.00	170.00	1.00	170.00	1.00	170.00
Net total		$80,205.25						
Contingencies, 15%		12,030.79						
Totals		$92,236.04		$141,135.50		$117,275.50		$111,251.00

a state highway. The work is located in Los Angeles County, Division 7, Route 9, Section A.

The materials furnished by the state cost $39,422.50 and comprised: Pipe railing for culvert, reinforcing steel, corrugated metal pipe, Portland cement and asphaltic oil surfacing.

Bids On Paving In Philadelphia

Fred C. Dunlap, Chief of the Bureau of Highways in Philadelphia, reports the following bids received on grading and paving on Sept. 5, 1917:

Schedule "A"—Grading.

Total amount of low bids.....$222.68

586 cu. yds. fill (425 cu. yds. cut). Average price of $0.38 per cu. yd.

Low Bidder. *Address.*
Edw. Ganley.....7116 York Road

Schedule "B"—Asphalt Paving.

Total cost of low bids.....$41,001.06

Asphalt pavement, including 6-in. concrete base. Average price of $2.751 per sq. yd.

Low Bidders. *Addresses.*
Mack Paving & Constr. Co.—Nicetown, La. & Whitaker Ave.
Barber Asphalt Paving Co.....Land Title Building
Philadelphia Paving Co.....1345 Arch St.

Schedule "C"—Vitrified Block Paving.

Total amount of low bids.....$12,059.59

Vitrified block pavement, including 6-in. concrete base. Average price of $3.71 per sq. yd.

Low Bidders. *Addresses.*
Cunningham Paving and Construction Co.....1345 Arch St.
Mack Paving and Constr. Co....Nicetown, La. & Whitaker Ave.

Schedule "D"—Bituminous Concrete Paving.

Total amount of low bids.....$10,751.38

Bituminous concrete pavement (Spec. "A"), including 6-in. concrete vase. Average price of $3.25 per sq. yd.

Low Bidder, *Address,*
Philadelphia Paving Co.....1345 Arch St.

Schedule "E"—Granolithic Footway Paving.

Total amount of low bids.....$2,431.20

Granolithic footway paving, including 6-in. cinder base. Average price of $1.71 per sq. yd.

Low Bidder. *Address.*
Reed & O'Rourke.....1213 Cherry St.

Schedule "F"—Asphalt Repaving.

Total amount of low bids.....$24,818.13

Asphalt repaving, including 6-in. concrete base. Average price of $2.416 per sq. yd.

Disposing of old pavement and sub-grading. Average price of $0.67 per sq. yd.

Low Bidders. *Addresses.*
Barber Asphalt Paving Co.....Land Title Building
Mack Paving & Constr. Co.....Nicetown, La. & Whitaker Ave.

Schedule "G"—Vitrified Block Repaving.

Total amount of low bids.....$2,544.70

Vitrified block repaving, including 6-in. concrete base. Average price of $3.513 per sq. yd.

Disposing of old pavement and sub-grading. Average price of $0.40 per sq. yd.

Low Bidder. *Address.*
Cunningham Paving & Constr. Co.....1345 Arch St.

Schedule "H"—Wood Block Repaving.

Total amount of low bids.....$4,607.98

Wood block repaving, including 6-in. concrete base. Average price of $4.013 per sq. yd.

Disposing of old pavement and sub-grading. Average price of $0.48 per sq. yd.

Low Bidder. *Address.*
E. C. Fish & Co.....Real Estate Trust Bldg.

FIRE ENGINEERING

Fire Tests of Building Columns

The Associated Factory Mutual Fire Insurance Companies, the National Board of Fire Underwriters and the Bureau of Standards of the Department of Commerce are jointly conducting fire tests of building columns at Underwriters' Laboratories, 207 East Ohio street, Chicago. The first test was run June 28, and it is planned to run about two tests per week throughout a period of twelve months. The time for the tests

is scheduled and may be ascertained in advance by those having a proper interest in the subject.

Types of Columns and of Column Protection.

The types of columns being tested include rolled steel sections, built up steel sections, round cast iron sections, steel pipe filled with concrete and vertically reinforced and hooped concrete columns, to which it is proposed to add several wooden columns. At least one of each of the sections is unprotected, others are partially protected by concrete and others completely protected by various thicknesses of concrete, clay tile, filled and unfilled, gypsum blocks, plaster on metal lath and common brick, in accordance with the methods commonly employed in practice.

The tests on unprotected columns are made to furnish information as to the ability of the columns to withstand fire, and to obtain information relative to the influence of the type of column section, which latter forms a basis for comparison of the various methods of column protection.

Columns partly protected by filling the re-entrant portions with concrete are introduced as a type made necessary where space limitations prevent the use of full protection. Besides giving information on the merits of this type of protection as compared with unprotected steel, cast iron and wooden columns, it is also thought that they will give further data on the influence of type of steel section on fire resistance.

Of the 24 tests devoted to full concrete protection, the 8 made on the rolled H section employ, with 3 exceptions, all of the concrete aggregates used in the full series of tests. This is done to give comparison between the rolled H section and the other sections with the same thickness of covering made of the same aggregate, and also to compare the efficiencies of the various concretes in point of heat insulation and fire resistance.

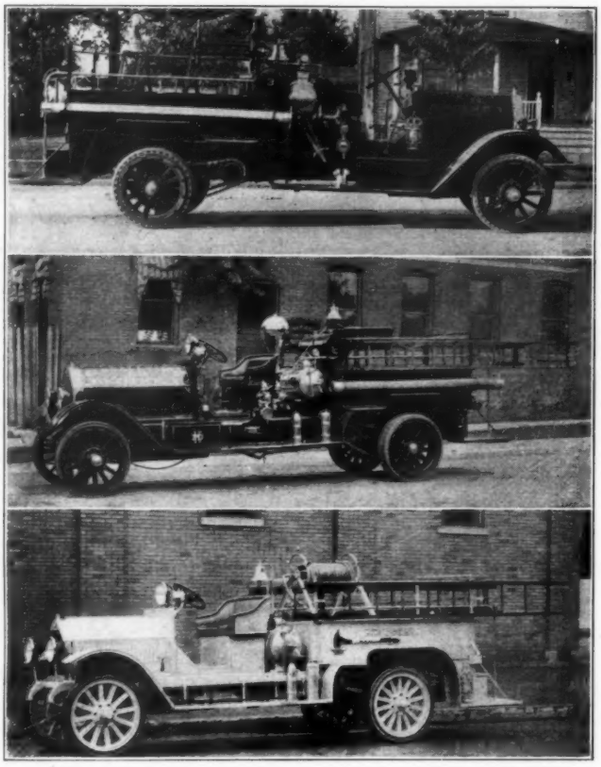
The reinforced concrete tests, consisting of 3 vertically reinforced square columns, 3 vertically reinforced round columns, and 3 spirally hooped and vertically reinforced columns, are designed to show the effect of shape of column, and also the effect of type of reinforcement on fire resistance.

The column coverings have been applied by experienced men in accordance with plans and specifications drawn to secure average results obtained under ordinary commercial conditions.

Some New Motor Fire Apparatus

The City of Muncie, Ind., has recently placed in service two of the South Bend Double Duty Hoosier Pumps. The Hoosier pumps are a triple combination fire engine. The motor is a 95 H. P. power 5¾x7-in., 4-cylinder motor with Leece-Neville starter and lighting system. They are 500-gal. per minute capacity, 40-gal. chemical tanks and are on Goodyear cushion tires. One of the Muncie units is here illustrated.

The illustration shows also a unit recently delivered in Kendallville, Ind., which is a 500-gal., 6-cylinder machine. This unit is a 5¾x7-in., 6-cylinder motor.



UPPER—TRIPLE COMBINATION FIRE ENGINE, MUNCIE, IND. MIDDLE—NEW MOTOR FIRE APPARATUS, KENDALLVILLE, IND. LOWER—COMBINATION CHEMICAL AND HOSE WAGON, NEWBURGH, N. Y.

Another view is shown of a South Bend type CH-60 combination chemical and hose wagon, with a 4¾x5½-in., 4-cycle motor with a Westinghouse starter and lighting system, 40-gal. chemical tank and also all the necessary equipment, as shown.

This unit is for the Ringgold Hose Co., Newburgh, N. Y. It is finished in pearl gray and is decorated in silver.

SALES ENGINEERING

What a Concrete Building Selling Campaign Should Embrace and What Should Be Avoided

By J. P. H. Perry, Contract Manager, Turner Construction Co., New York City

Selling a concrete building to its owner, now that reinforced concrete is so widely accepted as a meritorious material for industrial buildings, usually really means the getting of the contract to erect such a building. It seems to me that fundamentally it makes little difference whether we are out to get a lump-sum contract, a cost-plus-percentage contract or a cost-and-profit-sharing contract, or any of the many service forms of building contracts—the underlying principle is to get the job. The perfect salesman for this class of business is the fellow who can get the contract, said Mr. Perry, in addressing the Salesmanship Congress.

Form of Contract of Secondary Importance

It has been my experience that contractors weaken their selling campaigns the moment they attempt to dictate to the prospective customer how that customer shall do his business. Our position has always been that we were out to sell our services to our customers on any fair basis and that the form of contract they chose was of secondary importance.

Suppose you hear of a factory that is going to be built and you decide you want the contract:

You've got considerable of a task to make the proper approach and interest your prospect in your proposition. Perhaps you have, first of all, to sell concrete as compared to steel or mill construction, if the status of the building, so far as material or construction is concerned, is not already established. That accomplished, either by you or previously, next comes the actual contract getting, talking points, such as your company's record of work done, its present readiness to erect the building in question, its financial strength and the perfection of its organization. Then the merits have to be made clear of such factors as the plant ready to send to the job at once, the liveness of the traffic department, the speed records and what certainty of delivery means, and, above all else, dependability of performance.

To drive home to the buyer's inner consciousness, to that part of him which actually moves himself as distinct from the external casual momentary side of him, these selling arguments; and also to make each of the many other talking points count and win; to tell this story so that the listener will believe it, and, what is more, believe it so he knows unalterably that what is back of the salesman is the best on the market—all this is ordinarily as much as the salesman can hope to accomplish.

If you bring up the question of the particular form of contract that the contractor will alone accept, you add to the salesman's task and bring in a new element, which really is a subject by itself and but a detail of the big selling problem.

What Intensive Selling Methods Have Accomplished

The statement has been made that no selling is possible except when the contract takes the form of a service or percentage document. I want to take exception to this statement. I know of many instances where hard, intensive selling—such, for example, as interviews, telephone calls, frequent telegrams, photographs, monthly, weekly, daily, twice a day, influence channels properly worked, printed literature, inspection trips to similar jobs—where such good hard sweating has landed the contract at a preference in the straightest and hardest kind of competitions.

Two instances, particularly, are in my mind—one a competition of lump-sum bidding of ten bidders for three-quarters of a million dollar job, where the fifth from the bottom bidder secured the job at $60,000 preference. Hard selling, backed by unblemished reputation and unusual speed records, influenced the board of directors to pay the premium. Another case of a nearly million dollar job. Thirteen bidders, the pick of the country, straight-lump bids, nearly $80,000 preference to the ninth highest bidder. Selling did it.

The intelligent owner starts out not to buy a particular kind of contract, but to select the contractor he believes will serve him best. Of course, if the contractor can persuade the owner to award the job without competition so much the better, and for this kind of a deal the service or percentage contract has many merits and advantages and is rapidly coming into force. In fact, the writer's company, out of 32 concrete buildings contracted for in the first five months of 1917, handled 26 on a cost and percentage basis. But, as far as the general selling problem is concerned the form of contract is secondary. Sell your services first and then sit down with the lawyers to sign the papers. The contract form is but one of the great building salesman's many talking points—to be used as needed.

The Two Classes of Industrial Executives

Industrial executives in letting building contracts may, in my experience, be divided into two broad classes, and I believe this division applies pretty widely to any set of buyers: First, the man (or company) who wants what he wants more than the money it costs; second, the fellow who thinks more about the price than he does about his purchase.

Number One you can sell. He wants a good building built on time and is willing to pay a fair price. Secure his confidence and let him write his own contract (whether he takes competition or not depends on the salesman or on unchangeable conditions). There is, as other builders have well pointed out, no better line of attack than to reach your man through his own industry or his own friends. Another good way to sell buildings is to let some one else sell for you. Impartial opinion, real or ostensible, goes miles beyond prejudiced salesman's talk. Architects or engineers should be cultivated to this end.

Often competitive bids are taken by this first class of buyers, but they select from their bids the concern they believe to be the best. Of course, price has to be considered, but is of secondary importance. A good building salesman keeps it there. The refusal of a job at a price other than your bid is a situation to be sought and of great value when secured.

Price Being Talked Out of Contracting Business

Number Two can also be sold, but it is a far harder accomplishment and rather rare, unless we consider getting a job on price selling. Personally, I think it is order taking. Price alone is being more and more talked out of the modern contracting business, but it's a mighty big factor yet.

The architect and the engineer are susceptible to the same line of thought as the owner. Of course, the details of approach, argument and closing are radically different, but the foregoing principles are fundamentally correct here as well.

In selling reinforced concrete buildings a man is arguing the merits of a material or of a class of construction.

Requirements Vital to Successful Selling

In getting a job the contractor is, of course, selling services—often the two problems dovetail. It seems to me, however, that for either or both the following requirements are vital to successful selling.

First. Perfect your organization to the point where it can and does do what is claimed for it. Overstatements of merit give but temporary success.

Second. Advertise energetically and as extensively as your purse affords. Job signs, booklets, photographs, magazines, newspapers—all are effective.

Third. Intensively sell by means of men of pleasant personality who know their game; that is, are experienced in the concrete construction field, can design broadly and advise knowingly and, above all, who have energy and courage and won't take no.

Salesmen You Ought to Know.

When it comes to representing a large number of well-known lines few agents for contractors' equipment have anything on our friend, George F. Smith, of Franklin and Channing avenues, St. Louis, Mo. Since 1910 he has represented the Clyde Iron Works of Duluth, Minn., the Sasgen Derrick Co. of Chicago and the Smith Engineering Works of Milwaukee. For two years he has represented the Insley Manufacturing Company of Indianapolis, for one year the Blaw-Knox Co. of Pittsburgh, for two years the Novo Engine Co. of Lansing, Mich., and for four years his neighbor, the Whitman Agricultural Co. of St. Louis. He covers the southern half of Illinois and the eastern half of Missouri. He offers his customers a force of trained mechanics, a large stock of equipment available at rush notice, repairs for their machines and an organization to reduce delays and expense to a minimum.

Carey Floyd Lawrence, of Greensboro, N. C., is optimistic by nature and predicts that the war will be over by September 1, 1918. His cheerful view of things results, no doubt, from his success in representing the Lewis-Hall Iron Works of Detroit, the Denman Motor Co. of Cleveland and the Detroit Trailer Co. of Detroit, Mich. He covers North Carolina and makes a hobby as well as a business of selling motor trucks. And they say he owns as many Liberty Loan bonds as any man in the state.

Washington Irvin Thompson, of Jackson, Mich., knows, personally, every contractor, street and road builder in Michigan, and also in Toledo, Ohio, and in northern Indiana. He goes through the Lower Peninsula with a fine tooth comb and makes side trips to Toledo and Fort Wayne. He has specialized in the sale of Kelly Springfield road rollers since the first

W. I. THOMPSON.

of 1909 and sells twenty-five of them in a year, on the average. Another hobby of his is good roads. He has frequently addressed public meetings on this topic. He gets along famously with the contractors and, despite his open countenance, is a nifty poker player. He is thinking of adding several lines to his string.

It is good to reflect on the comfortable circumstances and salubrious surroundings of P. E. Longstreet, dealer in contractors, industrial and municipal supplies, who holds forth at 236 Marsh-Strong Bldg., Los Angeles, Cal. To begin with, he is favored by being the representative of such concerns as the Lakewood Engineering Co., the Minneapolis Steel and Machinery Co., the Thew Automatic Steam Shovel Co., the Heltzel Steel Form and Iron Works, Byer's Autocrane, Orton & Steinbrenner, F. D. Cummer & Sons Co., Tiffin Wagon Works, Webster Manufacturing Co. and Plymouth Locomotives. He also handles motors, generators and electrical apparatus and used equipment of all kinds. He is strategically stationed to intercept those who are coming and those who are going. And, as if representing so many such A-1 firms was not enough, he has the additional good fortune to live in Los Angeles and actually knows a lot of the screen ladies, with whom, he admits, he is a great favorite. As we have had occasion to remark before, some people sure do seem to have more than their share of the good luck.

F. R. Schoen, of the Burbank Machinery Company, of Seattle, Wash., persists in referring to this section of M. E. as the "Rogues' Gallery." Now he comes through with a picture of himself, his motor car and his two boys, named in the inverse order of their importance in his household. It is his misfortune to work in a business in which he is personally interested, so he has seldom had the pleasure of taking such a

F. R. SCHOEN.

vacation as is enjoyed annually by corporation employees. This year it was a bit different, and he loaded friend wife and the boys into the Ford and made for the north fork of the Snowqualmie River, where the accompanying view was taken. He has recently stocked his warehouse with all sorts of road machinery manufactured by the Western Wheeled Scraper Company, of Aurora, Ill. He is interested in practically all kinds of contractors' equipment.

PERSONAL ITEMS

J. Hinman has been appointed City Manager of Hanford, Calif.

C. A. McComber has been appointed City Manager of San Anselmo, Calif. He was formerly manager of the Marin Rock Co.

L. R. Cook has been appointed City Engineer of Nampan, Idaho, to succeed Ogden Dutcher, who resigned.

Herman C. Allen, Wallace, Idaho, has been appointed State Highway Engineer, to succeed E. M. Booth, who recently resigned.

Gerald T. Wagner has been appointed City Engineer of Grand Rapids, Mich., to succeed W. S. Moore, who for some months has been chief engineer of the Indiana State Highway Department.

John V. Brown is now manager of the Water Company at York, Nebr.

Paul W. Treanor was recently appointed commissioner of Water Works at Nashville, Tenn.

Robert Blakemore, for years commissioner of the Fargo, N. Dak., Water Works has been appointed Fuel Administrator for Cass County, Nebraska.

L. W. Allen has been appointed manager of the Alabama Water Co. plant at Anniston, Ala. He was formerly connected with the Birmingham Railway Light & Power Co.

G. E. Hoffmaster was recently elected president of the Birmingham, Ala., Water Works Co. to succeed A. M. Linn, who

is now president of the West Pennsylvania Railways Co. with headquarters at Pittsburg. Mr. Hoffmaster has long been in the service of the American Water and Electric Co. of New York. He has been at the head of various of the local water companies.

GEORGE H. TEFFT, for many years well known in the Clay Products Industry, is now secretary and general manager of the recently reorganized Clay Products Association. His offices are in the Chamber of Commerce Building, Chicago. Mr. Tefft is best known for his many years of service with W. S. Dickey, the Kansas City vitrified clay pipe manufacturer, and for his work as secretary of the International Clay Products Co., and as director of the Clay Products Exposition which has been held in connection with the annual meeting of the National Brick Manufacturers' Association.

T. B. SHERTZER has been made Eastern district engineer of the Hydrated Lime Bureau, Pittsburg, with offices in New York City. He was formerly an assistant engineer of the Bureau of Highway at Philadelphia, and more recently was city manager at Portsmouth, Va.

W. T. POTTER, of El Paso, and R. J. WINDROW, of Waco, Texas, have been appointed members of the State Board of Water Engineers by Governor Hobby. Mr. Potter succeeds Major John Wilson, of Barstow, who had been a member of the board since its formation, while Mr. Windrow fills the vacancy caused by the recent resignation of J. C. Nagle, who was chairman of the board. Mr. Windrow has for the past four years been County Engineer of McLennan County. Mr. Potter has been secretary of the board.

F. W. SCHREIBER, for the past seven years city engineer of Watertown, S. D., has been appointed assistant highway engineer of the South Dakota Highway Commission.

ARTHUR F. SHUEY, formerly assistant engineer of the Florida State Board of Health, has been appointed Superintendent of the Tampa, Fla., Water Works Company.

ERNEST MCCULLOH has joined the staff of Charles L. Pillsbury Co., engineers, of Minnesota and St. Paul, and will have charge of the civil engineering department. Mr. McCulloh is the author of well-known engineering books and has been a frequent contributor to engineering periodicals. He has also had extensive experience in city engineering work, notably in the City of Los Angeles. He also served for a time in the engineering staff of the United States Reclamation Service.

HOMER HAMLIN, until recently and for many years City Engineer of Los Angeles, Cal., has opened an office as consulting engineer and geologist with headquarters in the Central Building, Los Angeles. He will specialize in engineering and geological work connected with surface and underground drainage, water supply, sewerage, sewage disposal, irrigation, and will specialize in all municipal engineering problems.

CLIFFORD OLDER, for some years bridge engineer in the Illinois State Highway Department, has been appointed acting chief highway engineer of that state, to fill temporarily the position made vacant by the death of the State Highway Engineer, William W. Marr.

GEORGE L. CHRISTIAN has been appointed Deputy City Engineer of Yonkers, N. Y. He was formerly assistant engineer in the Department of Public Works in the Borough of Manhattan.

J. N. WELLS, of Kokomo, Ind., has been appointed superintendent of the Muncie, Ind., Water Co., to succeed the late Quincy Walling.

C. H. BUNDY, who for a time was acting superintendent following Mr. Walling's death, has been promoted to the superintendency of the Kokomo Water Co., to succeed Mr. Wells. Mr. Wells has been superintendent at Kokomo for 16 months and prior to that time was head of the Wichita, Kans., Water Co.

J. DENNY O'NEIL, of McKeesport, Pa., who was appointed State Highway Commissioner by his excellency, Governor Martin G. Brumbaugh, on September 6, 1917, was born in Elizabeth, Allegheny County, Pa., in 1866. He received his education in the public schools at Elizabeth and started work in early life. In 1885 he removed to McKeesport, where he engaged in the department store business. His rise in business, financial and political circles was rapid. He is president of the Union National Bank, the Daily News Publishing Co. and the J. D. O'Neil Co., all of McKeesport. He was also president of the State Merchants' Association and an officer of the Associated Dailies' Association of Pennsylvania. From 1902 to 1905 he served as Recorder of Dedes of Allegheny County and from 1908 to 1915 as County Commissioner. On June 23, 1916, Governor Brumbaugh appointed Mr. O'Neil Insurance Commissioner of Pennsylvania. During the short time he occupied this office notable work was accomplished by which many fraudulent companies were exposed and driven out of business. Mr. O'Neil's policy in connection with the work of the State Highway Department will be a vigorous one. Taking hold of the reins of this big department at a time when abnormal conditions exist, he has many serious obstacles to overcome. However, in the little over six weeks of his administration some important contracts have been let and it is expressed intention to link up the important highways of the commonwealth just as rapidly as possible. He is also working to better conditions on state roads within borough limits. Maintenance of trans-state highways during the winter months so that they will be passable at all times for the heavily increased motor truck traffic is receiving the commissioner's attention.

F. M. EDWARDS is the new City Engineer of Jacksonville, Fla.

CHARLES SCHULTZ has been made superintendent of Water Works at Kinney, Texas. He will continue to serve also as city engineer.

F. O. MCGILL, JOHN EDDY, B. E. CUNNINGHAM and L. E. MCKEETH will engage in the general contracting business under the firm name of Gem State Construction Co., with headquarters at Nampa, Idaho.

Following is a full roster of the officers of the 108th U. S. Engineers, formerly the First Regiment Engineers, Illinois National Guard, and the civilian positions they held prior to enlisting:

Staff.

Colonel Henry A. Allen—Mechanical, electrical and civil engineer.

Major Perry W. Swern—Member Berlin & Swern, Architects, Chicago, Ill.

Major Charles Roth—Factory Manager, Kitchen Service Co., Chicago Ill.

Captain Adjutant John J. O'Connor—Logging and railroad engineer.

Captain F. H. Cobb—Manager and superintendent Drafting Department, Meyer Both Co., Chicago, Ill.

Captain D. D. Guilfoil—Sales engineer, Sauerman Bros., Chicago, Ill.

Captain H. L. Laughlin—Engineer Erwing & Allen, Consulting Engineers, Chicago, Ill.

Captain Harry F. Hamlin—Director Massachusetts Tire and Rubber Co.

Lieutenant O. M. Caward (Chaplain)—Moderator Presbytery, Chicago, Ill.

Sanitary Corps.

Major R. J. McDonnell—Doctor.

Lieutenant Mark M. Duffy—Doctor.

Lieutenant Joseph W. Sanborn—Dentist.

Company A.

Captain C. C. Saner—Designing engineer Bureau of Engineering, City of Chicago.

Second Lieutenant Wm. H. Dean—Assistant engineer, Bureau of Engineering, City of Chicago.

Company B.

Captain B. C. Allin—Civil engineer Bridge Dept., C. R. I. & P.

First Lieutenant L. J. Hughes—Civil engineer, Bridge Department, C., R. I. & P.

S[illegible] Lieutenant F. R. Wiwi—Electrical engineer.

Company C.

First Lieutenant W. L. Hudson—Gas engine expert, Vehicle Bureau, City of Chicago.

First Lieutenant H. A. Roe—Assistant in Mechanical Engineer's office, Pullman Co., Chicago.

Second Lieutenant C. A. M. Waterhouse—Mechanical engineer.

Company D.

Captain A. H. Sheffield—Sales manager and construction engineer, Terre Cotta Construction, Chicago. Ill.

First Lieutenant L. R. Gurley—Estimating engineer, American Terr[illegible]ta and Ceramic Co., Chicago, Ill.

First Lieutenant F. R. Stauffer—Engineer L. K. Comstock Co., New York.

Second Lieutenant W. R. Wood—Engineering editor and publisher.

Company E.

Captain J. A. [illegible]er—Engineer track elevation and railroad expert for City of Chicago.

Fi[illegible]outenant J. H. Jacobson—Estimating engineer Com[illegible]ison Co., Chicago, Ill.

[illegible]ant Walter Farwell—Vice-president J. V. Far[illegible], Chicago, Ill.

Second Lieutenant Wm. H. Bready—Mechanical engineer Permutit Co. of New York.

Company F.

Captain R. C. Harris—Construction superintendent and architect.

First Lieutenant E. Lippe—Consulting engineer.

First Lieutenant C. L. Brundage—Structural Steel Dept., J. T. Ryerson & Son.

TRADE NOTES

R. D. Karnes & Son, Princeton, W. Va., have just received shipment of a 3-ton Stegman 6-cylinder dump truck, equipped complete with electric starter, electric lighting system, driver's cab, windshield and hydraulic hoist, intended for the County of Mercer, W. Va., to be used in road work.

H. M. Lee, president of the Duplex Truck Co. of Lansing, Mich., announces that Herman Loeffler has become a member of the Duplex sales department and will represent the company in the eastern states. Mr. Loeffler was connected with the Fairbanks-Morse Co. for 10 years, and for the last three years has been associated with the Novo Engine Co.

The appointment of George E. McLaughlin as Traffic Manager of the Dort Motor Car Co. of Flint, Mich., is further evidence of a tendency on the part of manufacturers to seek trained railroad men for positions of this nature. Mr. McLaughlin has been an employe of the Pere Marquette Railroad for 16 years, recently as trainmaster at Toledo. He brings to his new position a wide acquantance and popularity among railroad men, as well as proved executive ability.

The Standard Asphalt and Refining Company of Chicago, Ill., has purchased the plants, trade marks and good will of the Sarco Petroleum Products Companies. The Cities Service Company of 60 Wall street, New York city, is the new interest back of this company, although the management essentially remains the same as before the change. Mr. Charles Muller, who was an executive of the former company, now becomes manager. He has been associated with the old company for ten years and has risen through the ranks to his present position and is well known in business and financial circles in Chicago. Mr. Robert F. Trumbull has been promoted to manager of the railway and building materials department. He has been in the service of the old company for eight years in this department. By constant contact with the trade during that time he is intimately acquainted with its requirements for asphalt materials.

W. C. Rowley has been elected vice-president of the Federal Motor Truck Company of Detroit, and is also in charge of sales. He has long been a director and stockholder in the Federal Company. F. L. Pierce is now the Federal sales manager, Frank P. Soper, assistant sales manager, and E. W. Winans, service manager.

The Blaw-Knox Company of Pittsburgh, Pa., announce that they have closed their Boston office for the period of the war because of the heavy draft on their sales and engineering forces by the military establishment. All business of the Boston territory will be handled through the New York office at 165 Broadway.

H. S. Daniels, whose services have been for some time employed jointly by the Dort Motor Car Company and the Dooley-Brennan Company, will hereafter devote his entire time and attention to the advertising management of the Dort organization under the title of advertising manager. This new arrangement has necessitated the removal of Mr. Daniels from Detroit to Flint, where the Dort factory is located.

V. K. McBride, for the last three years assistant sales manager of the Federal Motor Truck Company, has resigned to become sales manager of the American Motor Truck Company of Detroit, Mich. Mr. McBride has a very wide acquaintance in the motor truck trade. When the Universal Truck Company initiated the deferred payment plan several years ago, Mr. McBride was the sales manager of that organization. Later he was sales manager of the Alden-Sampson Company, makers of trucks, a firm that was taken over by the Maxwell Motor Company, and later discontinued.

H. E. Hilts, formerly district engineer at San Francisco for the Portland Cement Association, has been elected by the board of directors of that body to succeed the late Mr. J. P. Beck as general manager.

The Stegeman Motor Car Company has just shipped one of its large 6-cylinder 4-ton dump trucks to Knox county, Ohio, for road construction work. The machine is equipped complete with electric-starter, electric-lighting system and hydraulic hoist, also cab and windshield. It was sold through the Good Roads Supply Company, 390 North High street, Columbus, Ohio, agents for contractors' equipment.

The Texas Company, New York City, has issued a 32-page illustrated booklet on Texaco Crater Compound. There is evidence in the booklet to show that marked economies can result from the use of Crater Compound instead of any lubricant that comes handy, from black oil to pitch and graphite. It is especially true of wire rope lubrication that substances are frequently used that are entirely unfit for this purpose. In collecting data on the subject this booklet should be secured by all means. The cost per foot of wire rope has reached an alarming point. The only way to overcome it is to get greater life.